Investigation and Simulation of Diffraction on Rough Surfaces

–Supplementary Material–

Introduction

In this supplemental document, we compare the fitting results with the Cook-Torrance GGX and our model as described in the paper. We fitted both models against the measured in-plane BRDFs of the six aluminum samples provided in this paper and against the in-plane BRDF of 24 ColorCheker patches as well as grey wall paint provided by Clausen et al. [CMF18].

As described in the paper, the fitting process of conductors and dielectrics are different. The refractive index of the aluminum samples is known. Therefore, only the alpha parameter (roughness) of the Cook-Torrance model and, additionally, the width and height parameter of the shift function of our BRDF model has to be determined. The refractive index of the ColorChecker patches is unknown and has to be further determined along with the diffuse albedo.

1 Dielectrics and Conductors

The fitting results are presented in five boxes for both dielectrics and conductors. In the following, the content of each box is described in detail.

1.1 Renderings

Using Mitsuba 2 [NDVZJ19], we rendered each fitted material with the Cook-Torrance GGX and our model. We extended the existing Mitsuba plugins *roughconductor* and *roughdielectric* to implement our BRDF models introduced in the paper. As scene, the matpreview scene provided by Mitsuba is used. The scene is slightly modified, we replaced the environment map by a spotlight in front of the object for conductors and another directional light source behind the object for dielectrics. In Mitsuba, the spectrum is represented by eight wavelengths. For sampling we used the independent sampler with 1000 samples.

1.2 RGB image of in-plane BRDF & dE 2000

In the top row, the RGB images of the in-plane BRDFs are presented. The three plots show the fitting results with the Cook-Torrance (left) and our model (right), as well as the measurement (center). The bottom row illustrates the respective dE 2000 between the fitted and the measured BRDFs. Each plot is subdivided into little squares, where each square represents a single measurement. The incident and reflection angles of the in-plane BRDF are plotted on the x- and y-axis, respectively.

1.3 Fitting results

The fitted parameters of the Cook-Torrance GGX and our model are presented. Additionally, for dielectrics, the fitted refractive index and diffuse albedo are presented.

1.4 Measured vs. fitted spectra

The figure consists of 17 subplots, where each subplot illustrates the fitted (red) and measured (green) BRDF spectra of the in-plane BRDF at a specific incident angle and for all reflection angles.

1.5 Measured vs. fitted scatter distribution at 600 nm

The figure consists of 17 subplots, where each subplot illustrates the fitted (red) and measured (green) BRDF at $600\,nm$ at a specific incident angle and for all reflection angles. Note that the figures for the Cook-Torrance GGX and our model are nearly identical because the shift function rotates the spectrum around $600\,nm$ in our model.

2 Only conductors

As presented in the paper, we measured the microsurface of the aluminum samples, and the refractive index is known. Therefore, we can provide further fitting results for the aluminum samples as presented in the following.

2.1 Measured vs. global fit of normalized BRDF

The three plots show the fitting result of the normalized in-plane BRDF with our global model, as described in the paper. On the left side, the measured normalized in-plane BRDF, in the middle, the fitting with the global model and on the right, the respective dE 2000 are illustrated.

2.2 Global fit of slope distribution

The figure consists of 17 subplots, where each subplot illustrates the slopes computed with the local (blue) and global (orange) approach at a specific incident angle and for all reflection angles. In the local approach, we compute the slopes by fitting the normalized in-plane BRDF with the following model

$$f_{norm}(i, \lambda) = (m\lambda + b) \cdot F^p(i, \lambda), \tag{1}$$

where m and b are, respectively, the slope and y-axis intersection of the linear function, and the exponent p takes into account the effect of multiple reflections. In the global approach, we fitted the slopes of the local fit with a simple cosine function

$$m_{cosine}(i, o) = h \cdot cos(w \cdot \theta_m) + t_y, \tag{2}$$

where w and h scale the cosine function in the x- and y-axis, respectively, and t_y translates along the y-axis.

2.3 Energy ratio - first vs. multiple reflections

The figure shows the decomposition of the light scattering of the aluminum samples into the first (blue) and multiple reflections (light blue) for different incident angles. The scattering on the surface is simulated with our virtual goniometer and the measured microsurfaces.

References

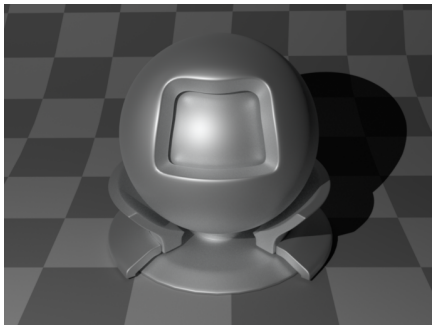
[CMF18] Clausen O., Marroquim R., Fuhrmann A.: Acquisition and validation of spectral ground truth data for predictive rendering of rough surfaces. In *Computer Graphics Forum* (2018), vol. 37, Wiley Online Library, pp. 1–12.

[NDVZJ19] Nimier-David M., Vicini D., Zeltner T., Jakob W.: Mitsuba 2: A retargetable forward and inverse renderer. *ACM Trans. Graph. 38*, 6 (nov 2019).

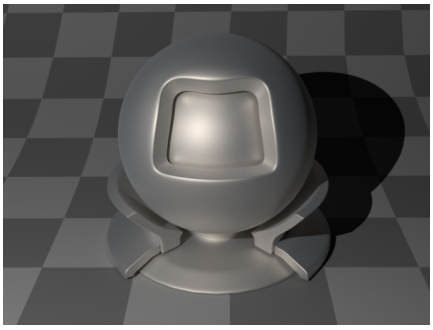
Aluminum Sample 1

Rendering
(Computed with Mitsuba 2)

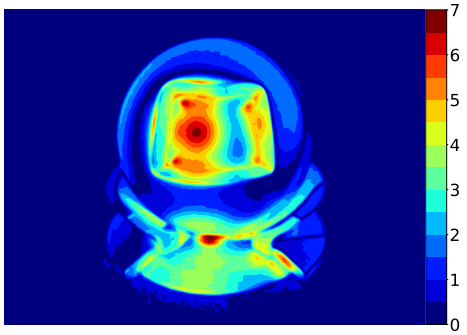
Cook-Torrance GGX



Our

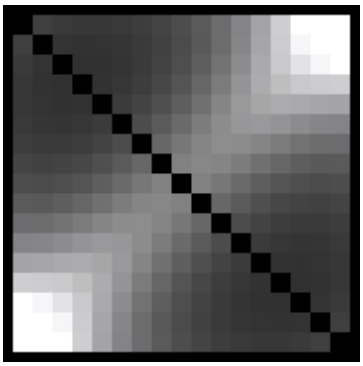


dE 2000

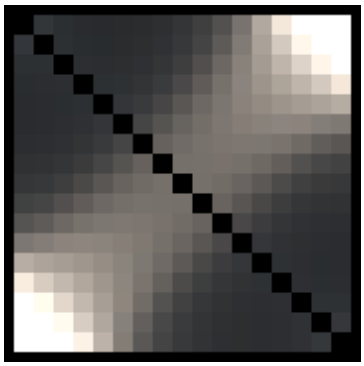


rgb image of
in-plane BRDF

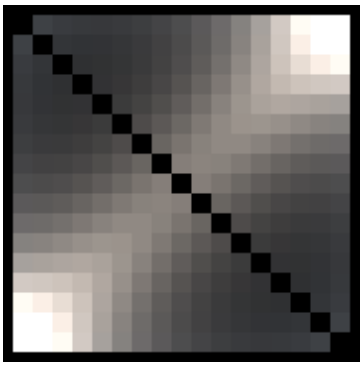
Cook-Torrance GGX



Measurement

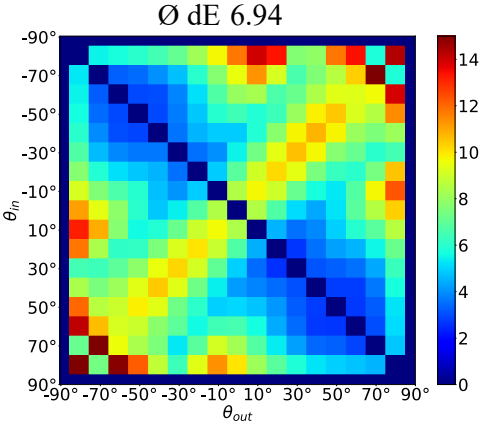


Our

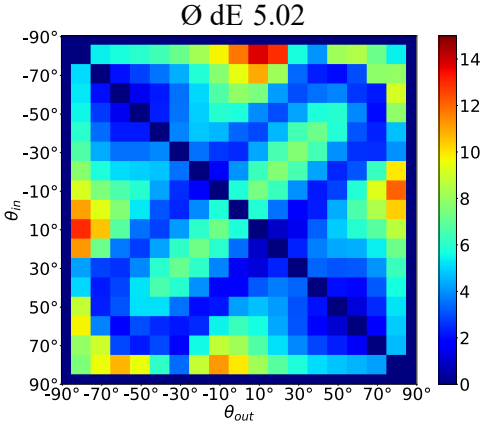


dE 2000

Ø dE 6.94



Ø dE 5.02



Fitting result

Cook-Torrance GGX

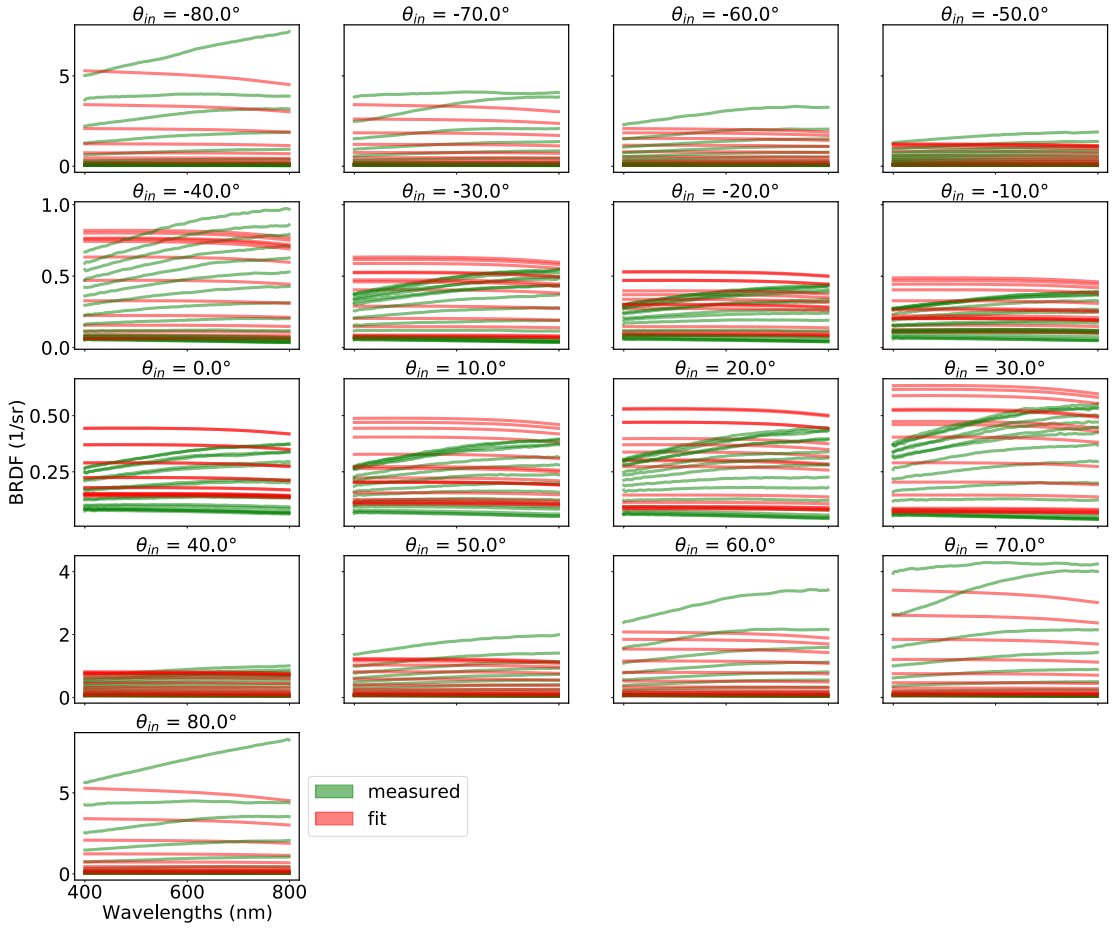
alpha = 0.3933

Our

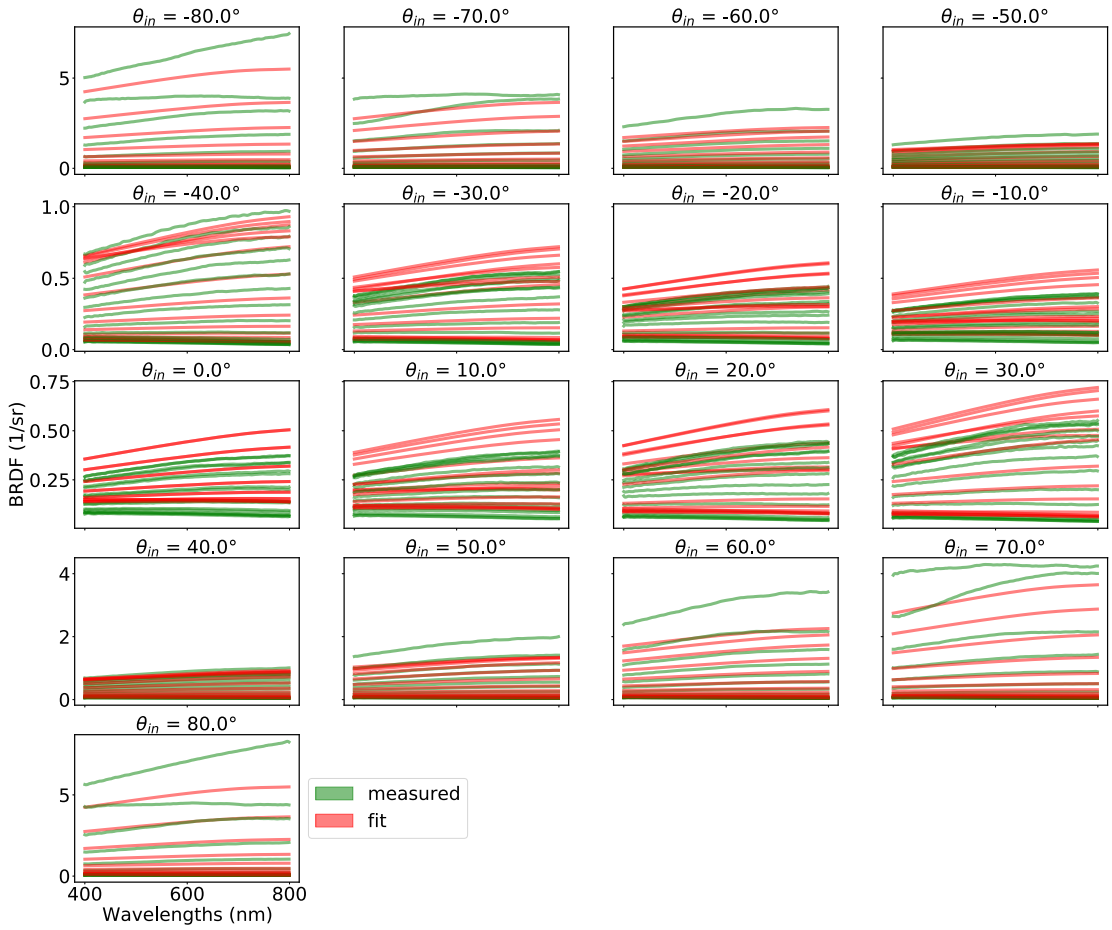
alpha = 0.3922
height = 1.03E-03
width = 2.3394

Measured vs. fitted spectra

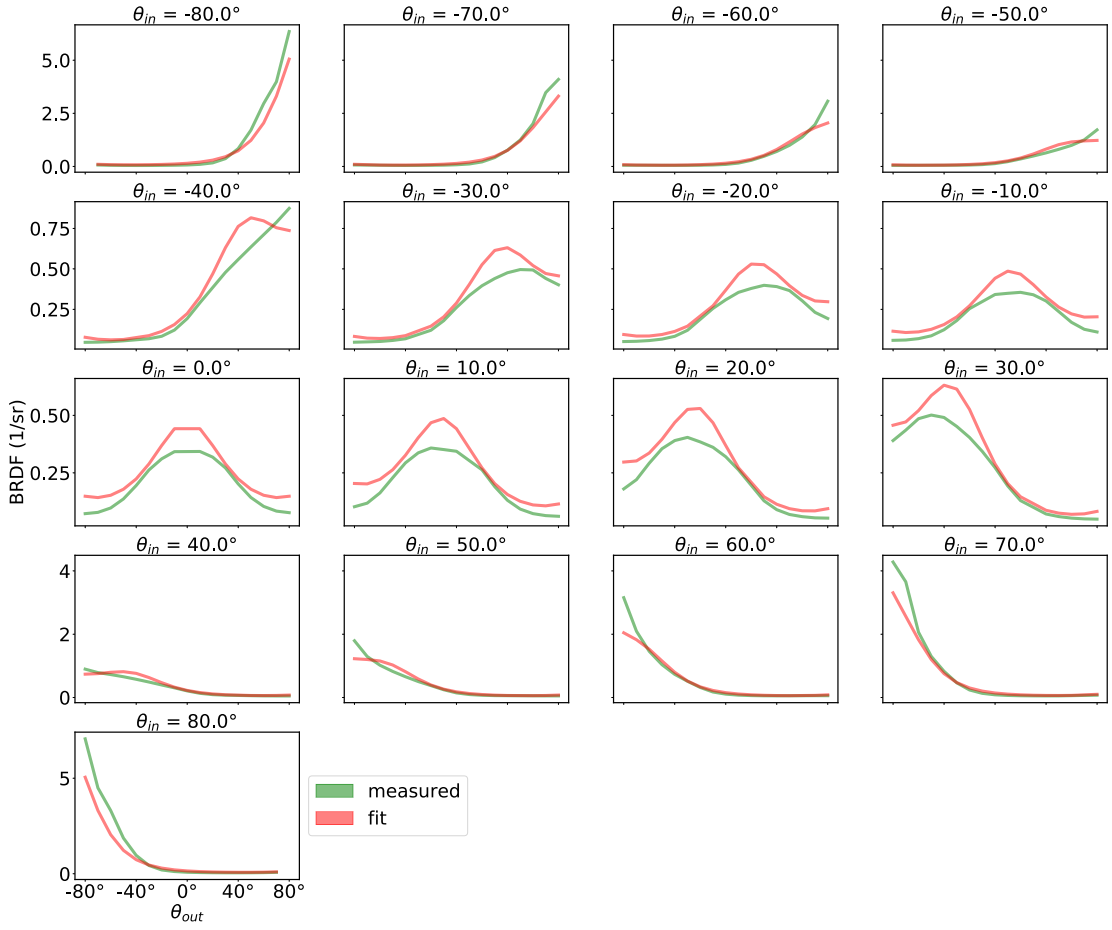
Cook-Torrance GGX

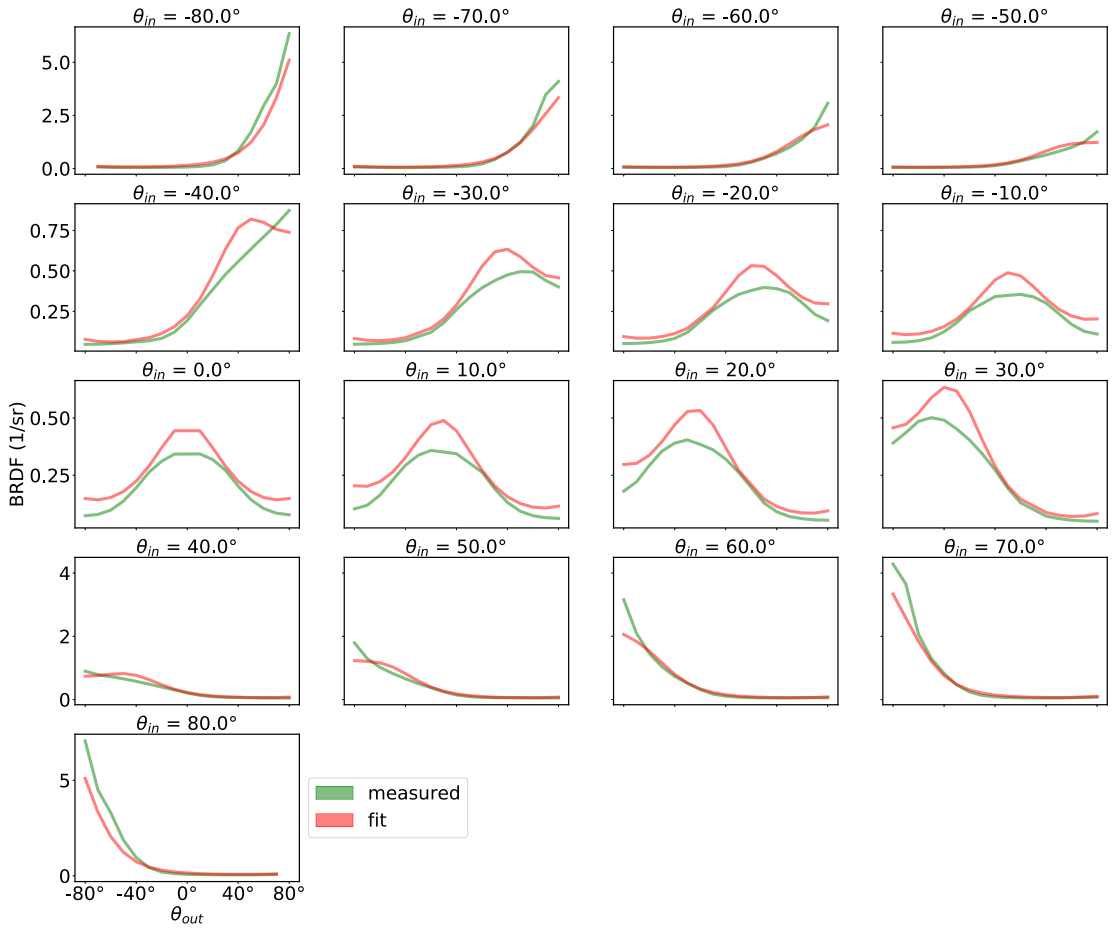


Our

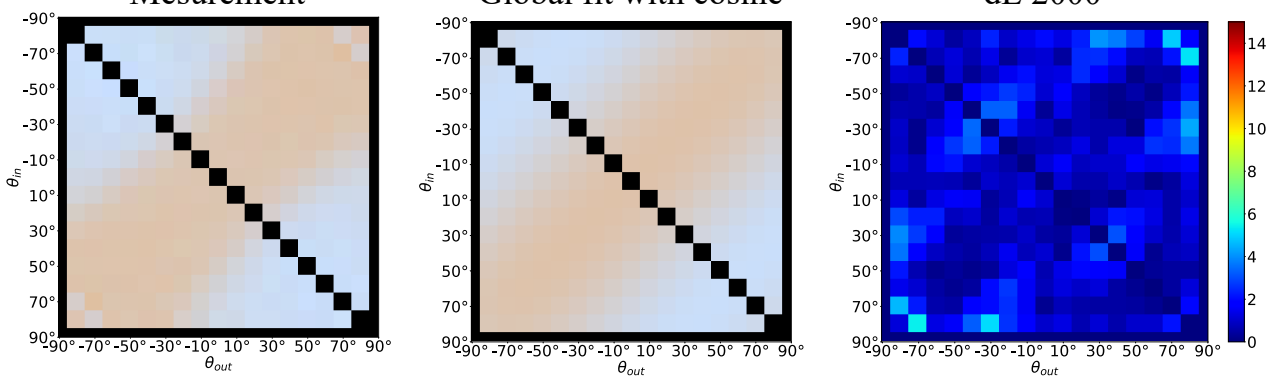


Measured vs. fitted
scatter distribution at 600 nm

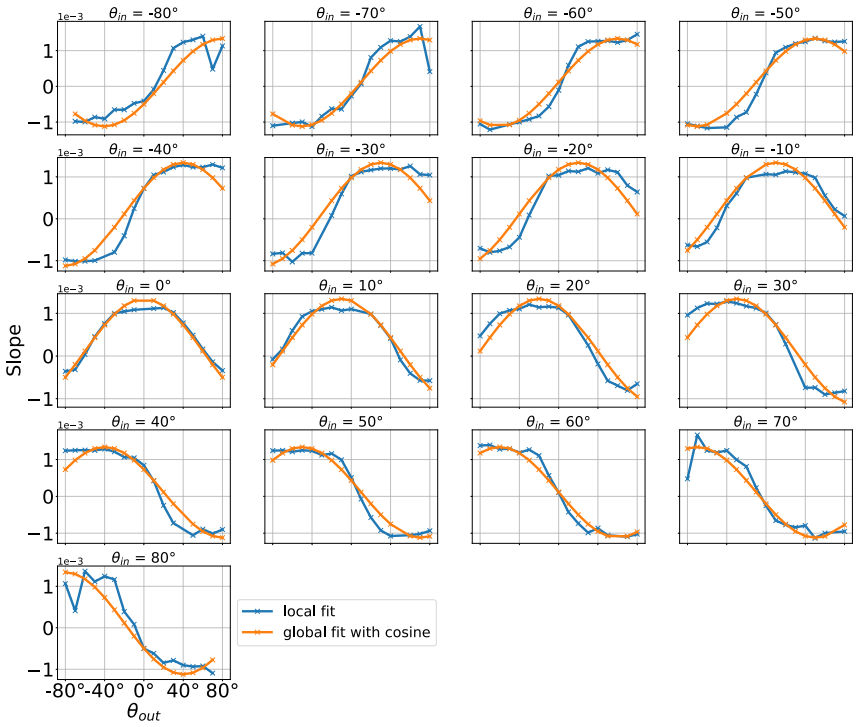




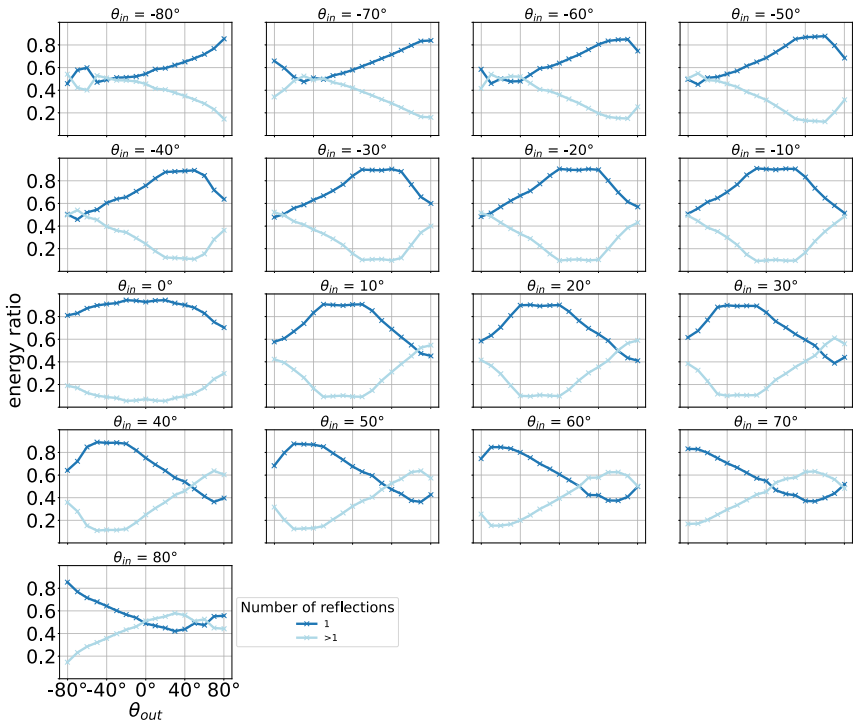
Measurement vs. global fit of normalized BRDF



Global fit of slope distribution



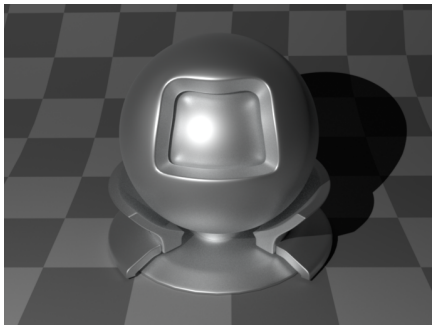
Energy ratio first vs. multiple reflections



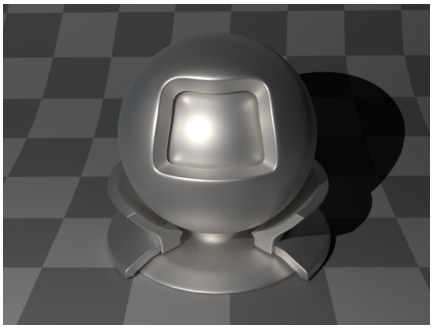
Aluminum Sample 2

Rendering (Computed with Mitsuba 2)

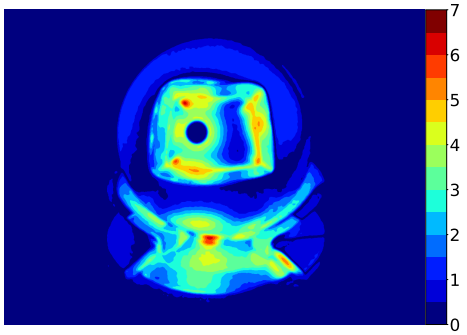
Cook-Torrance GGX



Our

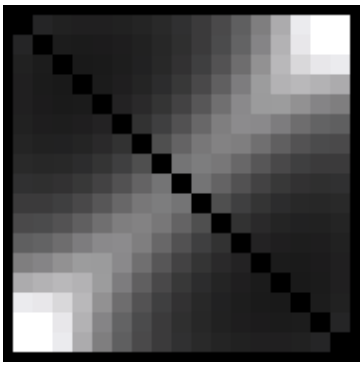


dE 2000

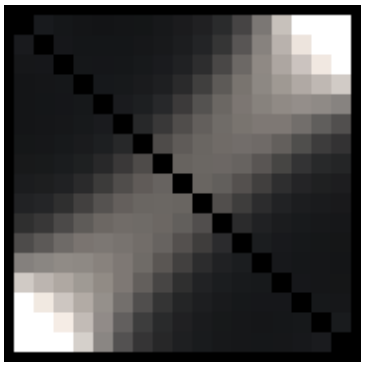


rgb image of in-plane BRDF

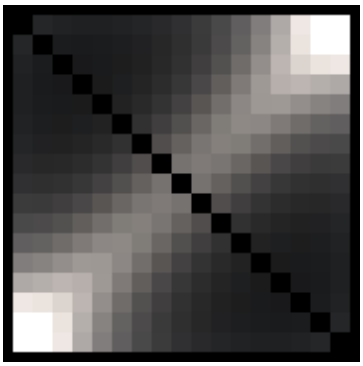
Cook-Torrance GGX



Measurement

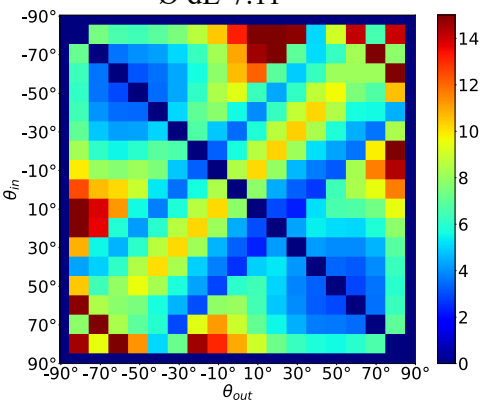


Our

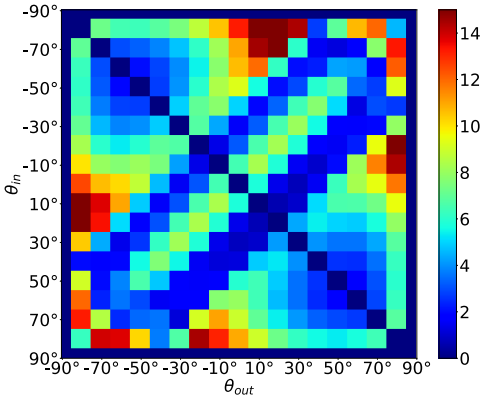


dE 2000

Ø dE 7.11



Ø dE 5.83



Fitting result

Cook-Torrance GGX

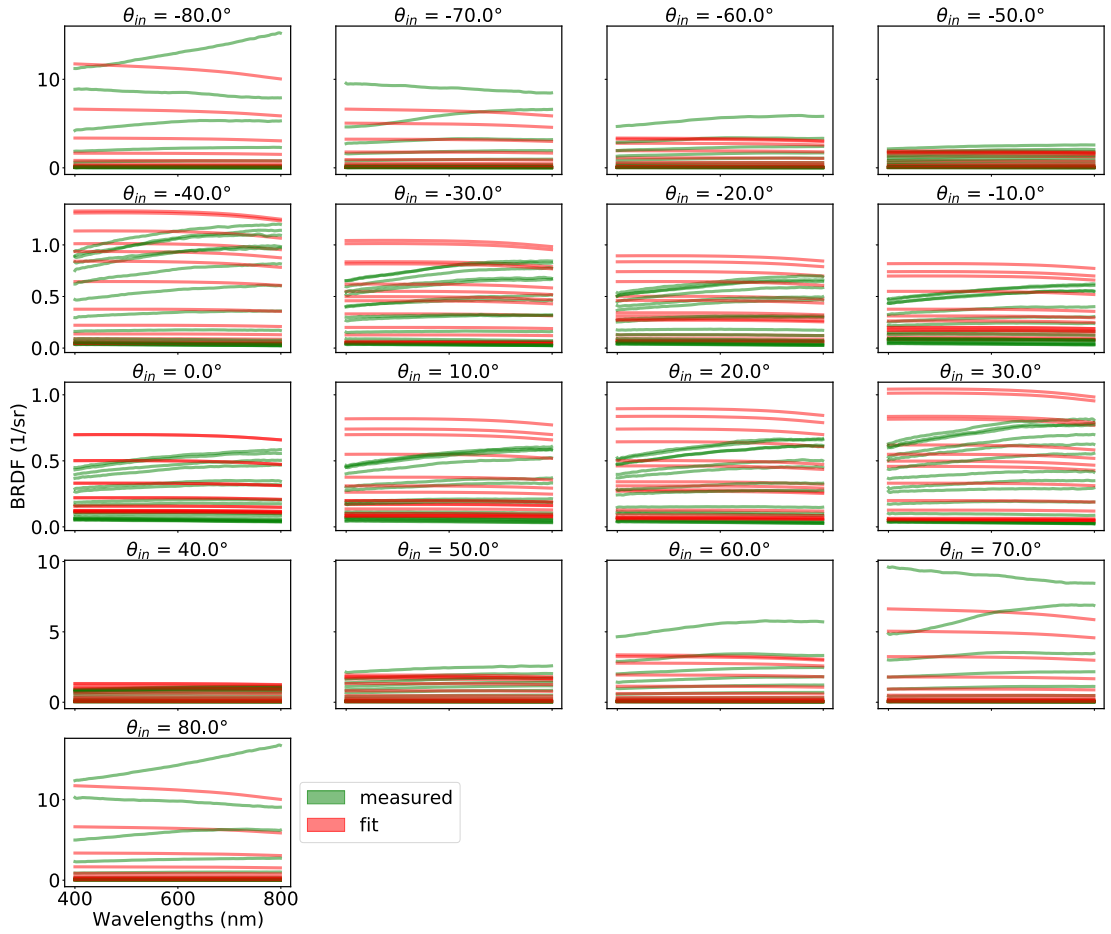
alpha = 0.3039

Our

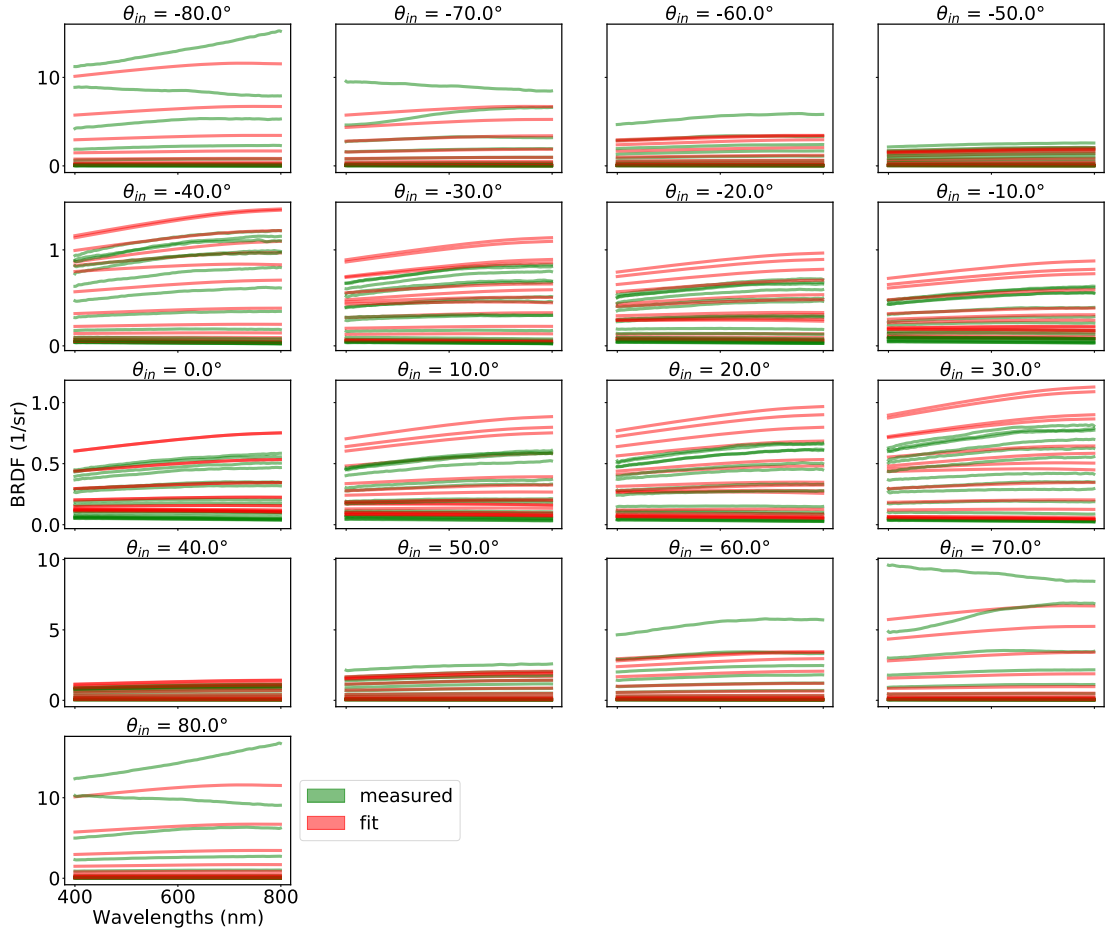
alpha = 0.3034
height = 7.13E-04
width = 2.7925

Measured vs. fitted spectra

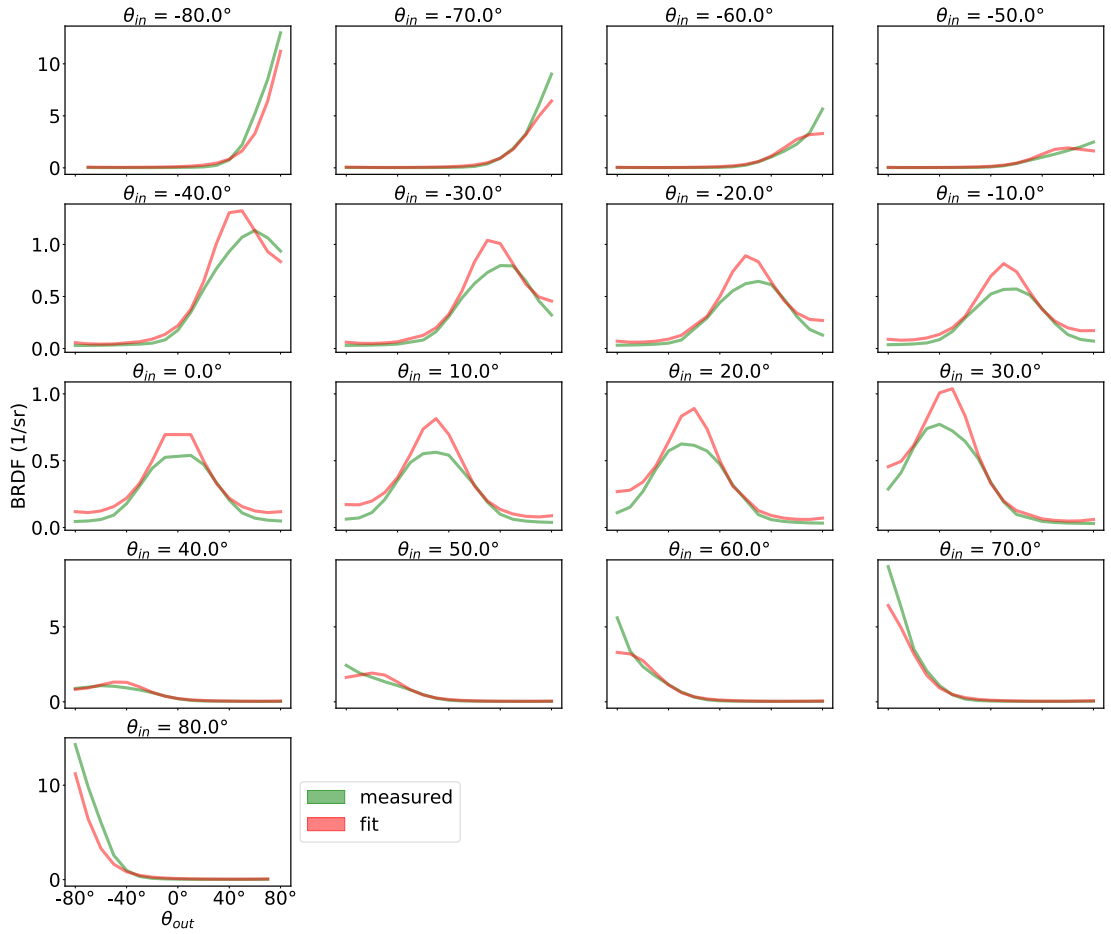
Cook-Torrance GGX

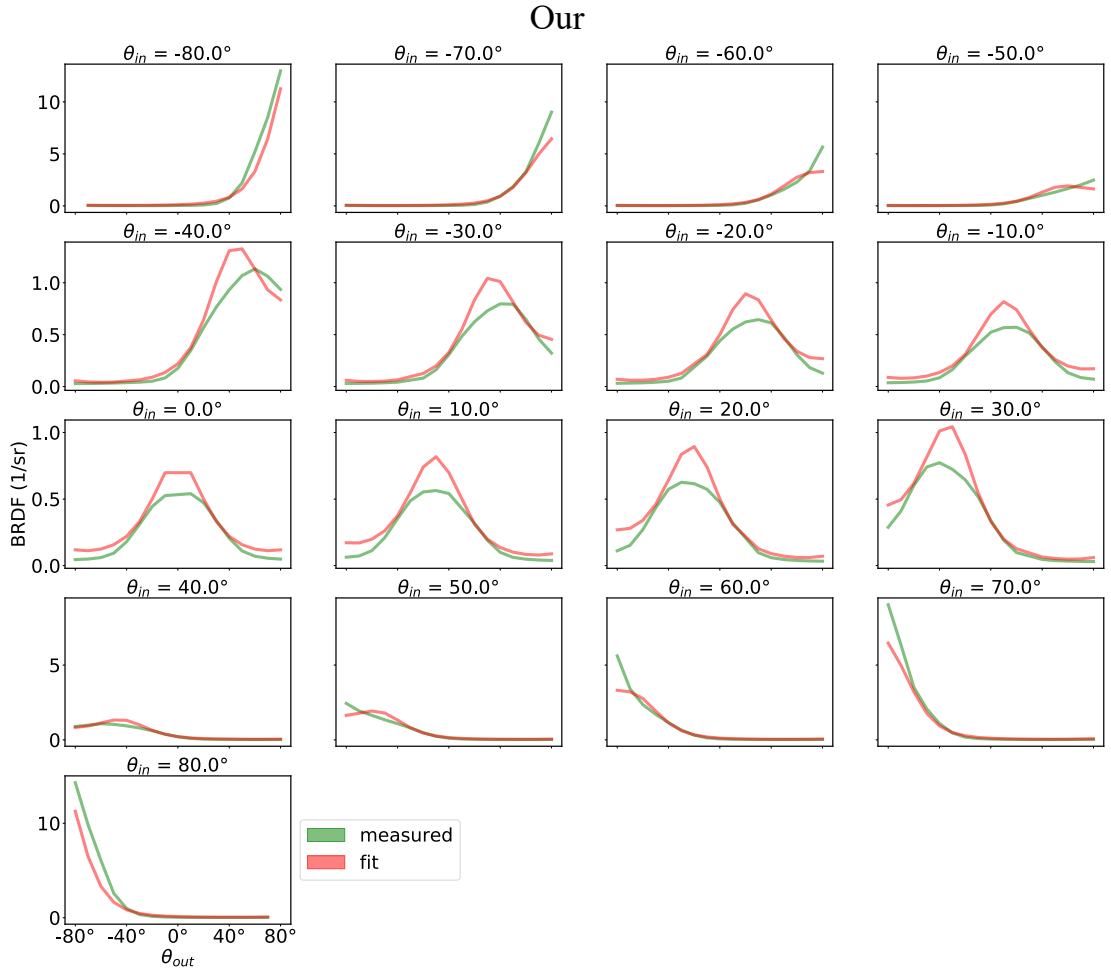


Our

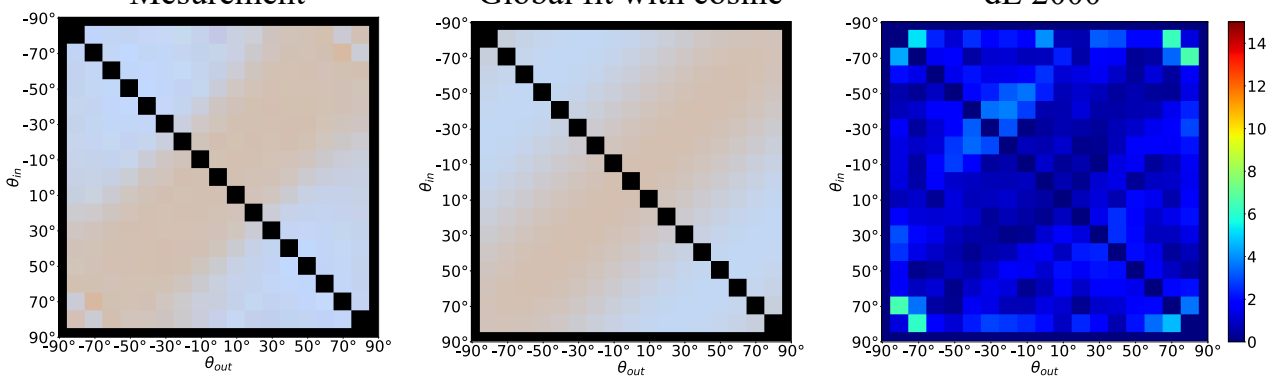


Measured vs. fitted
scatter distribution at 600 nm

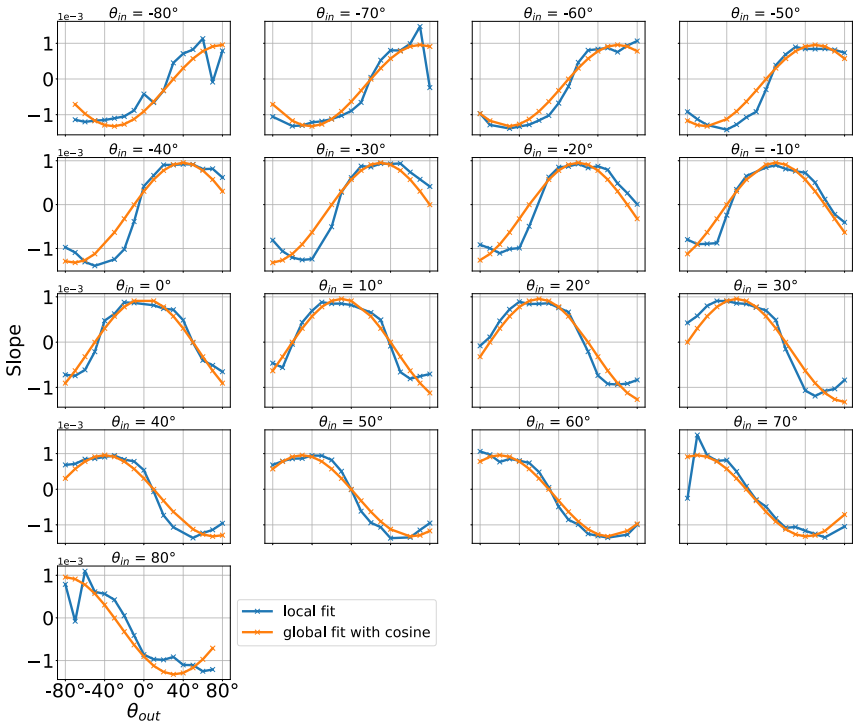




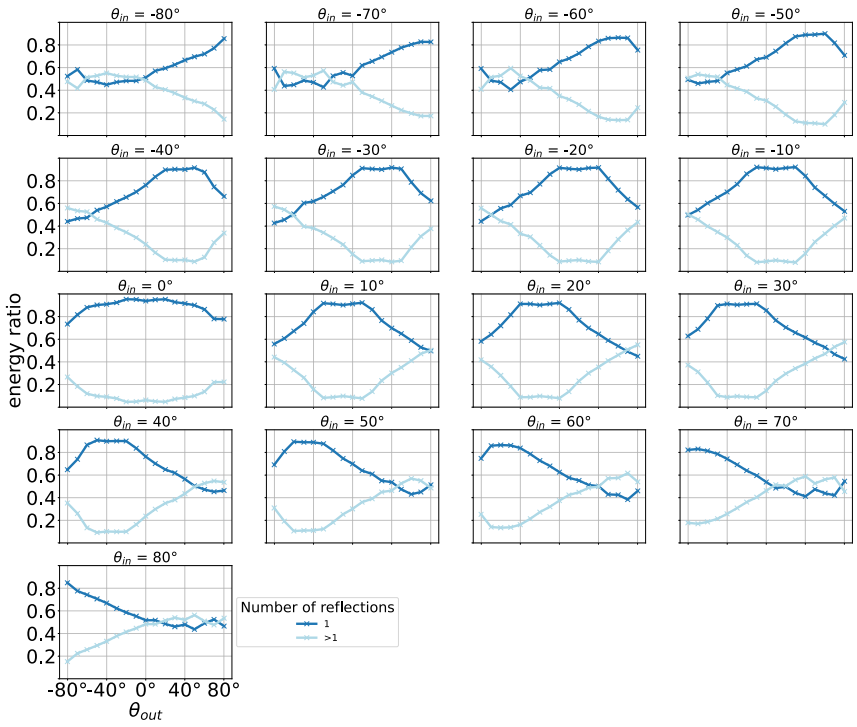
Measurement vs. global fit of normalized BRDF



Global fit of slope distribution



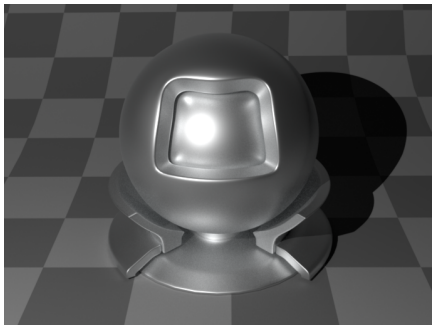
Energy ratio first vs. multiple reflections



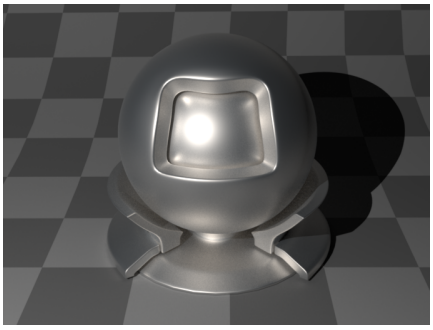
Aluminum Sample 3

Rendering
(Computed with Mitsuba 2)

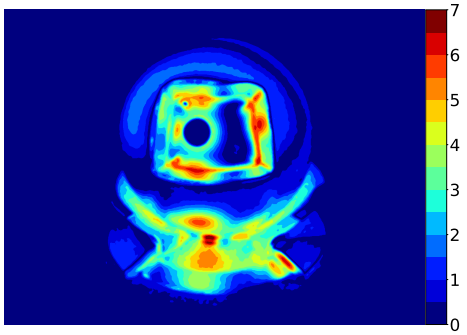
Cook-Torrance GGX



Our

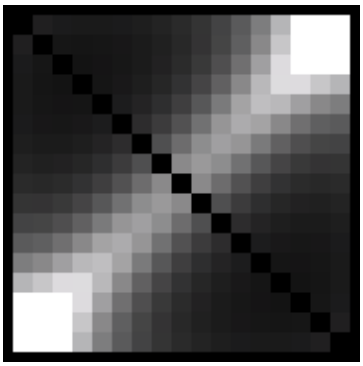


dE 2000

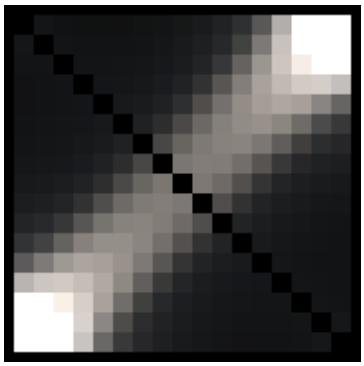


rgb image of
in-plane BRDF

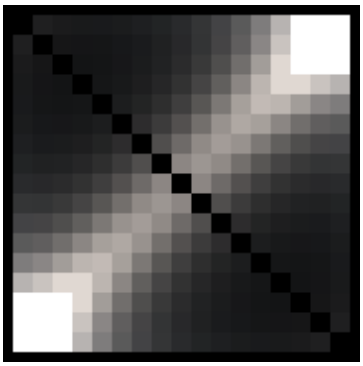
Cook-Torrance GGX



Measurement

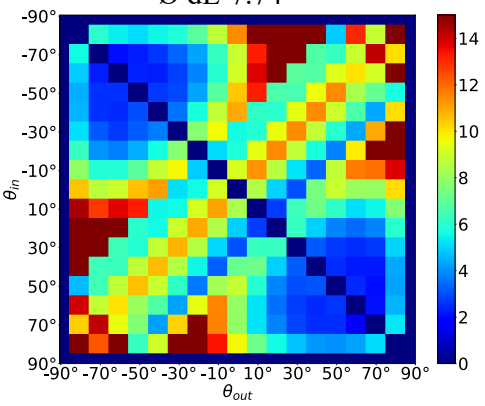


Our

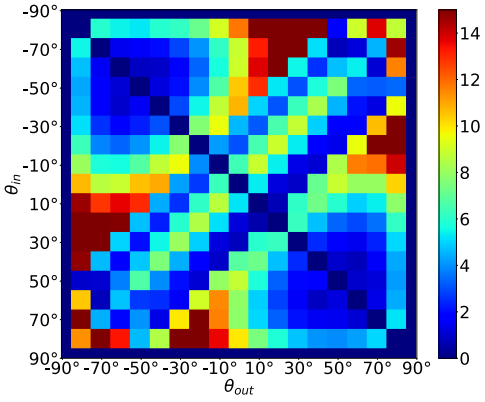


dE 2000

Ø dE 7.74



Ø dE 6.32



Fitting result

Cook-Torrance GGX

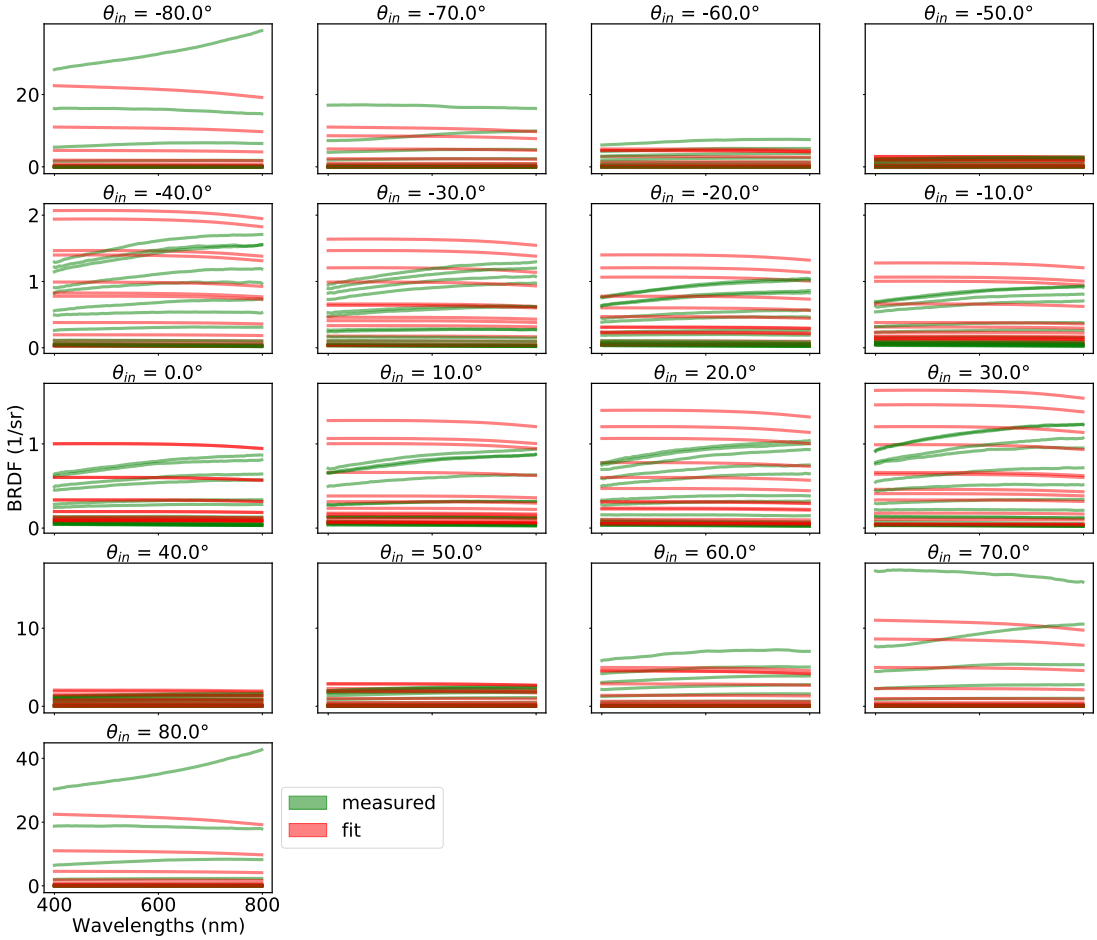
alpha = 0.2432

Our

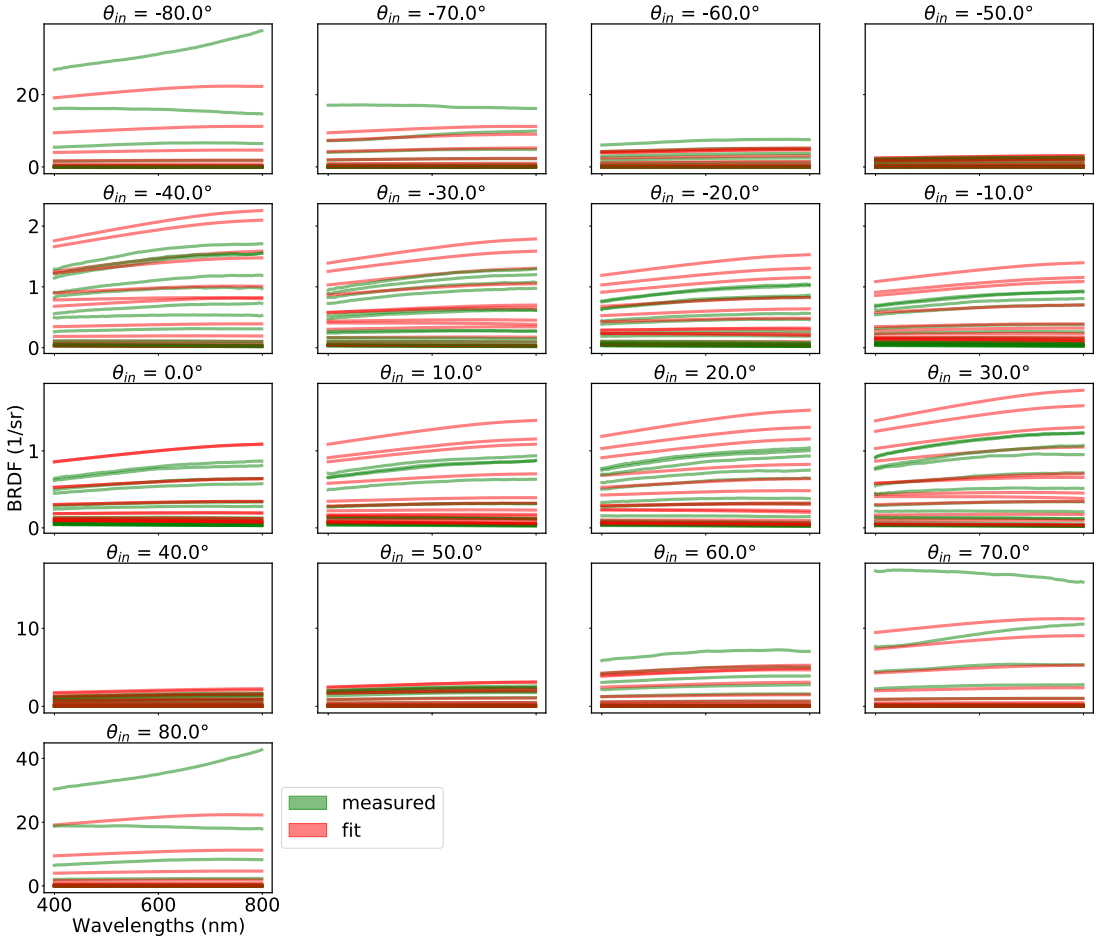
alpha = 0.2427
height = 7.67E-04
width = 3.5542

Measured vs. fitted spectra

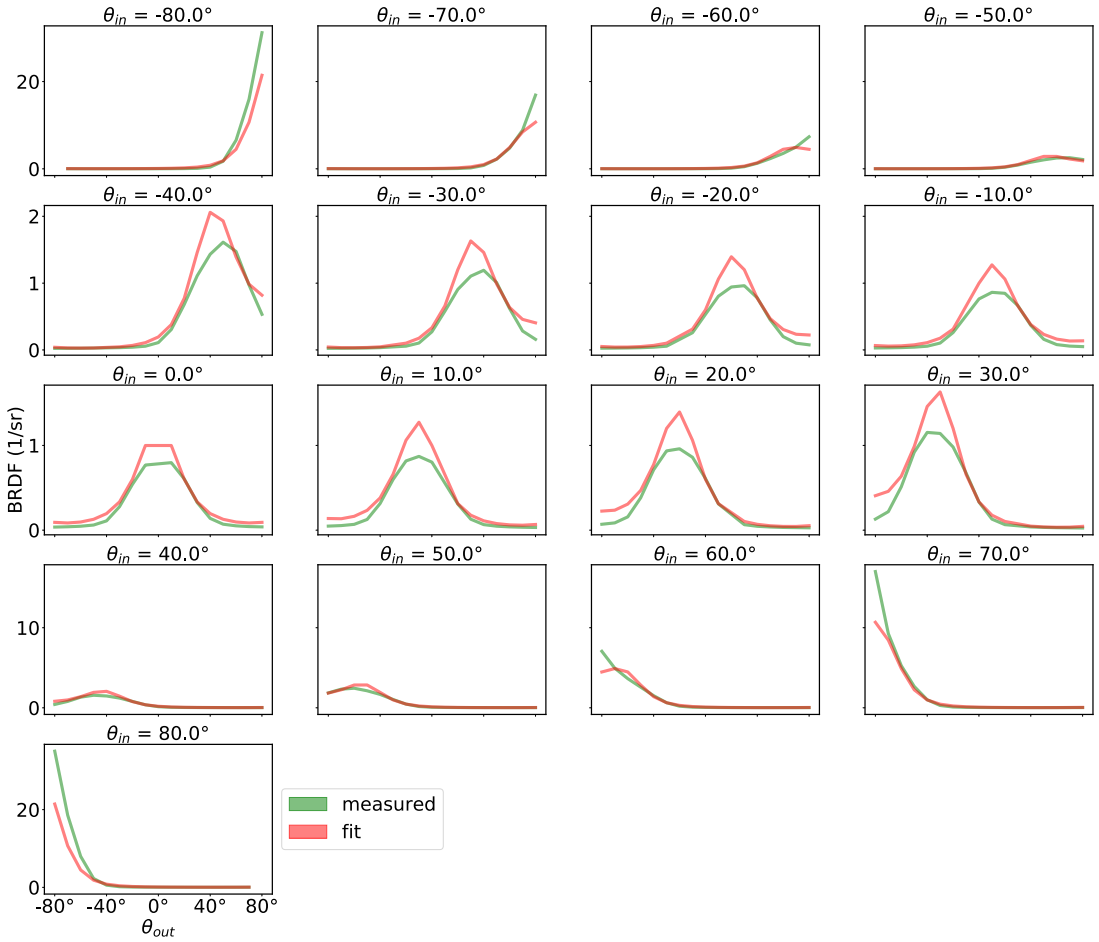
Cook-Torrance GGX

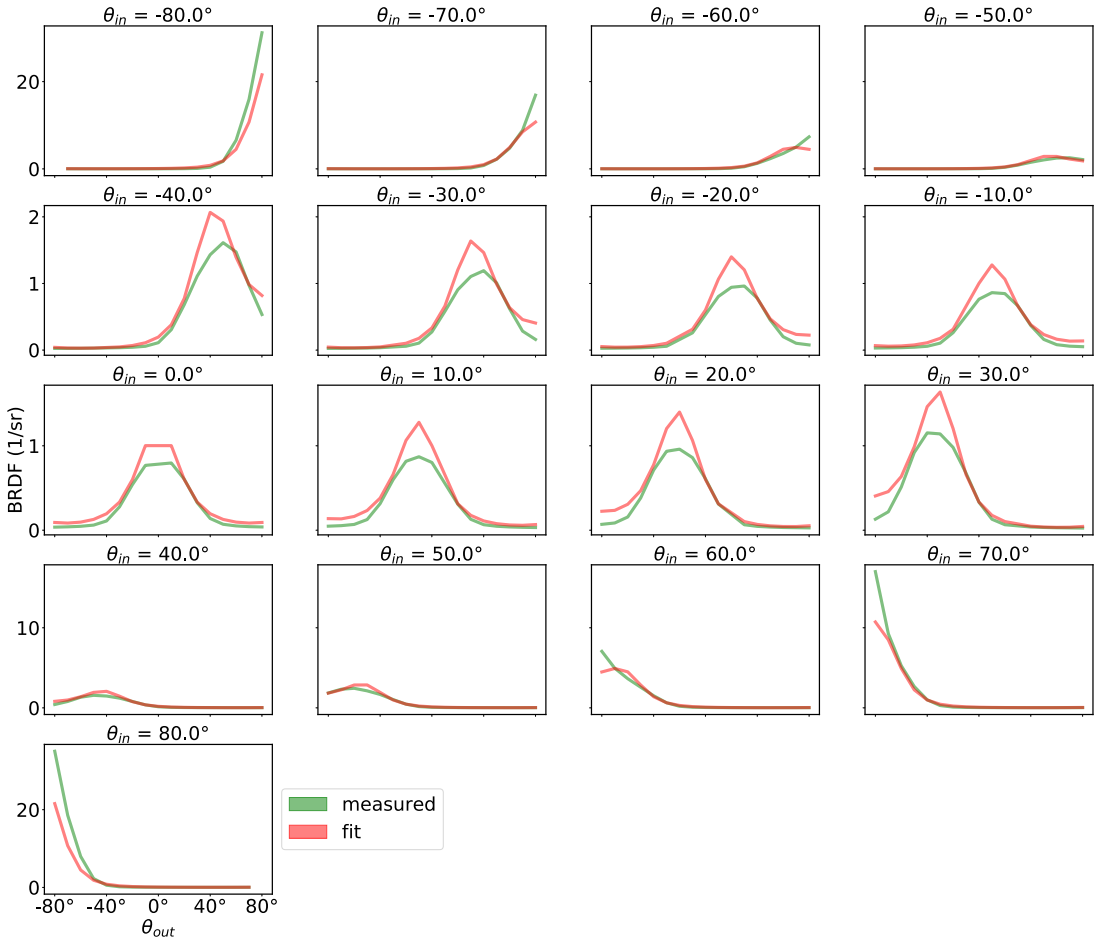


Our

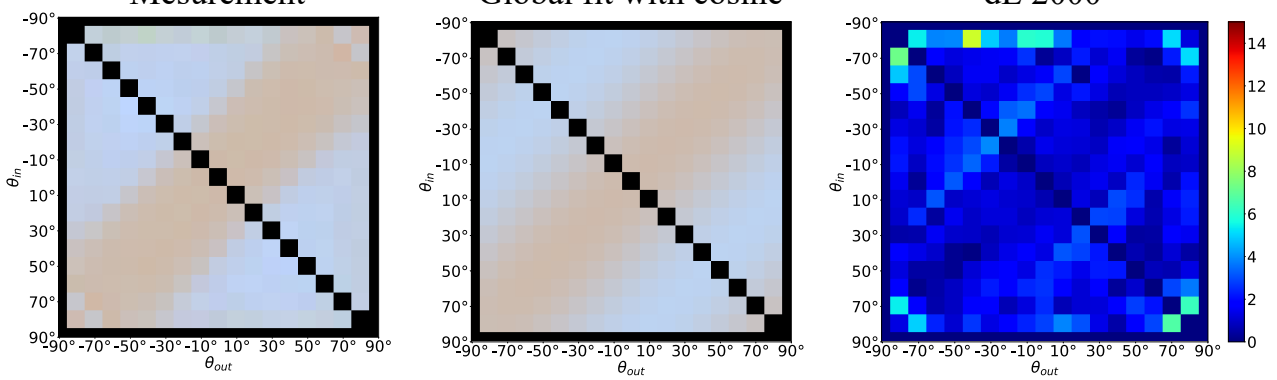


Measured vs. fitted
scatter distribution at 600 nm

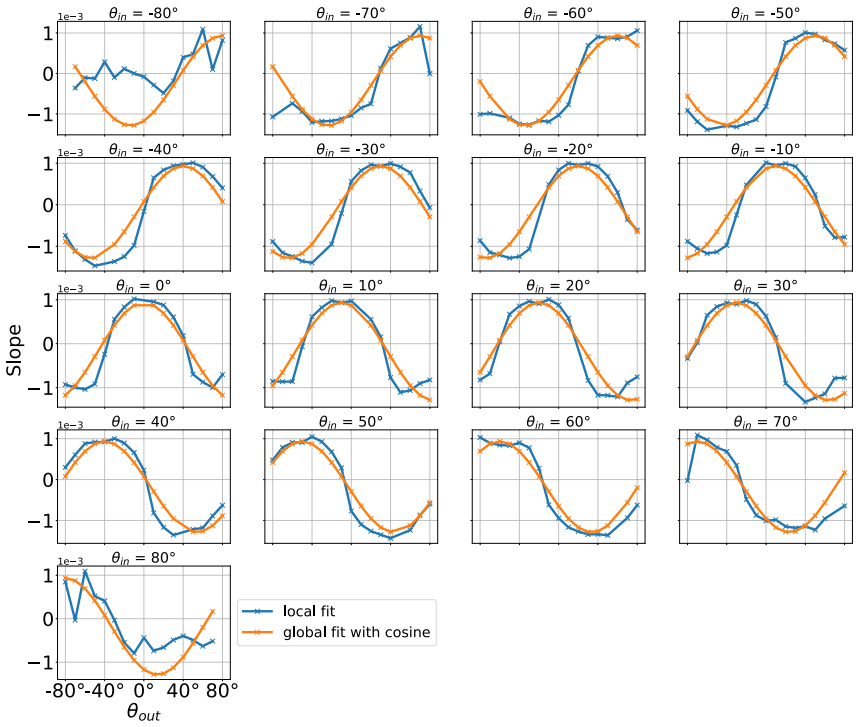




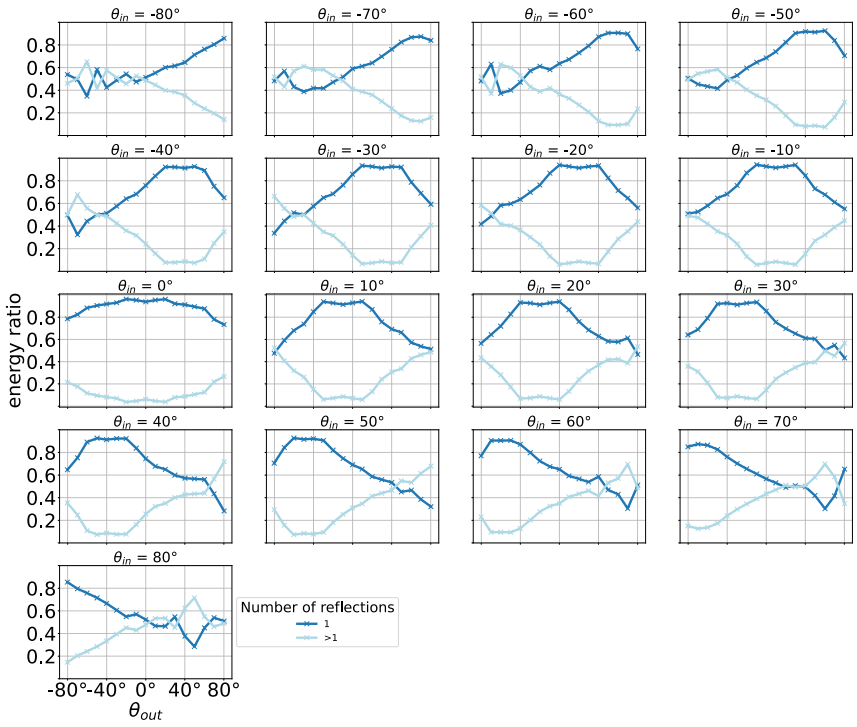
Measurement vs. global fit of normalized BRDF



Global fit of slope distribution



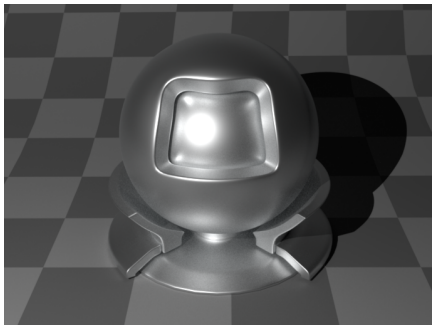
Energy ratio first vs. multiple reflections



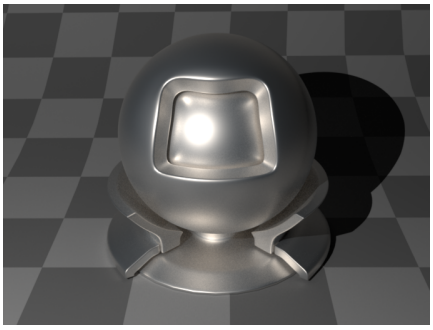
Aluminum Sample 4

Rendering (Computed with Mitsuba 2)

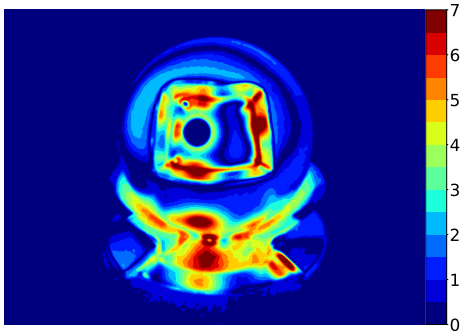
Cook-Torrance GGX



Our

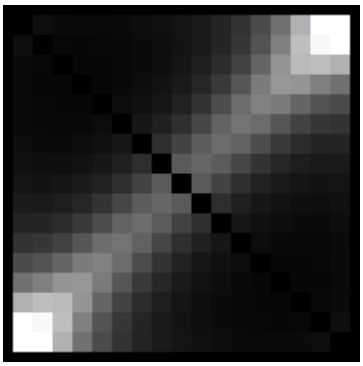


dE 2000

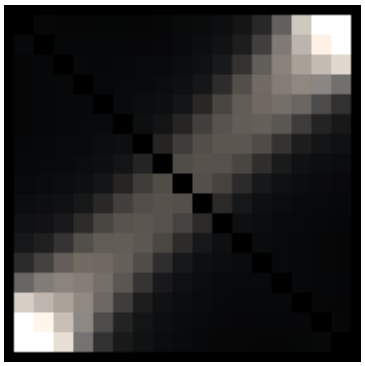


rgb image of in-plane BRDF

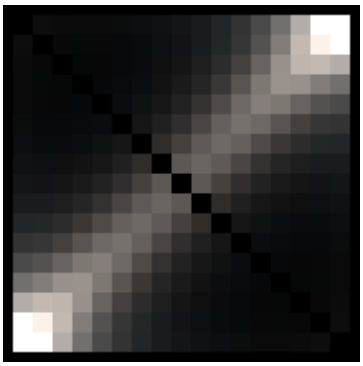
Cook-Torrance GGX



Measurement

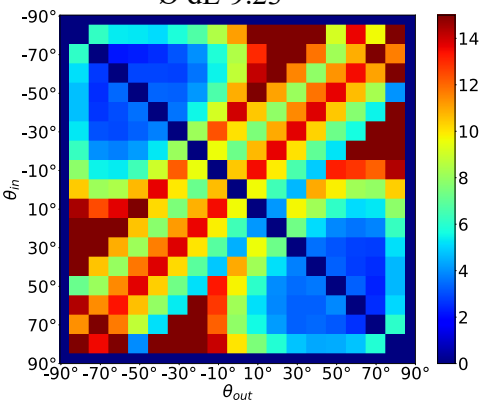


Our

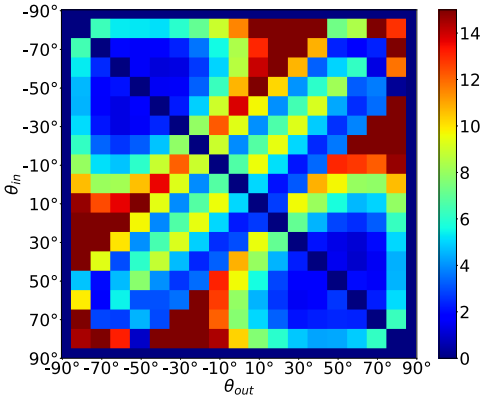


dE 2000

Ø dE 9.23



Ø dE 7.46



Fitting result

Cook-Torrance GGX

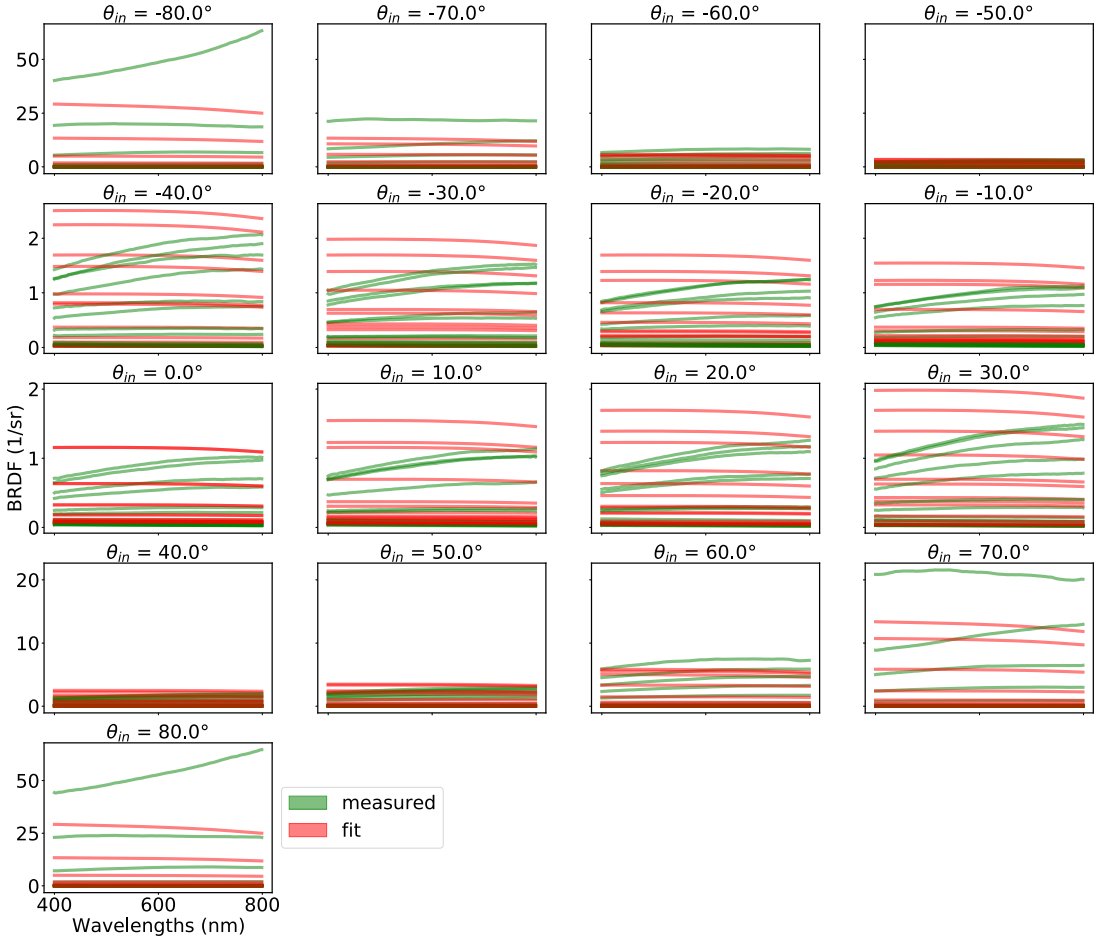
alpha = 0.2213

Our

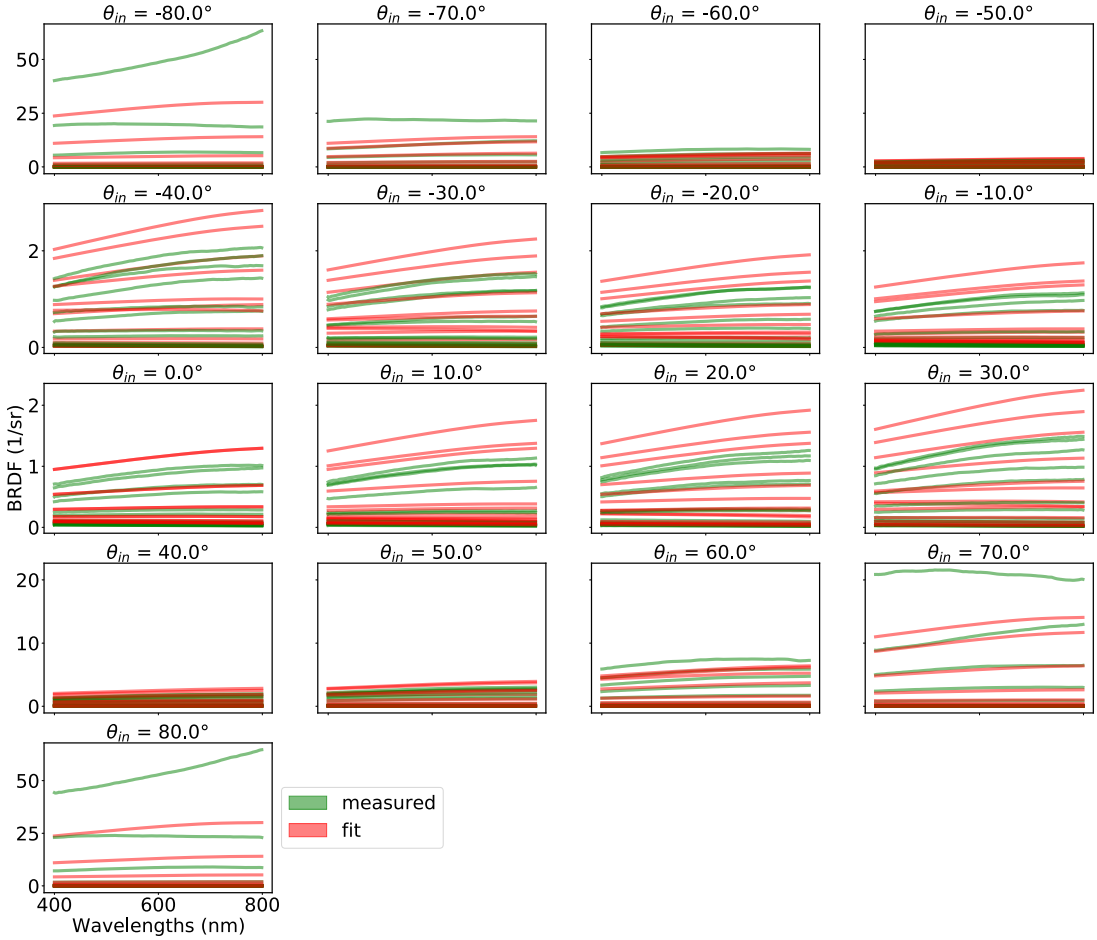
alpha = 0.2206
height = 9.73E-04
width = 4.0593

Measured vs. fitted spectra

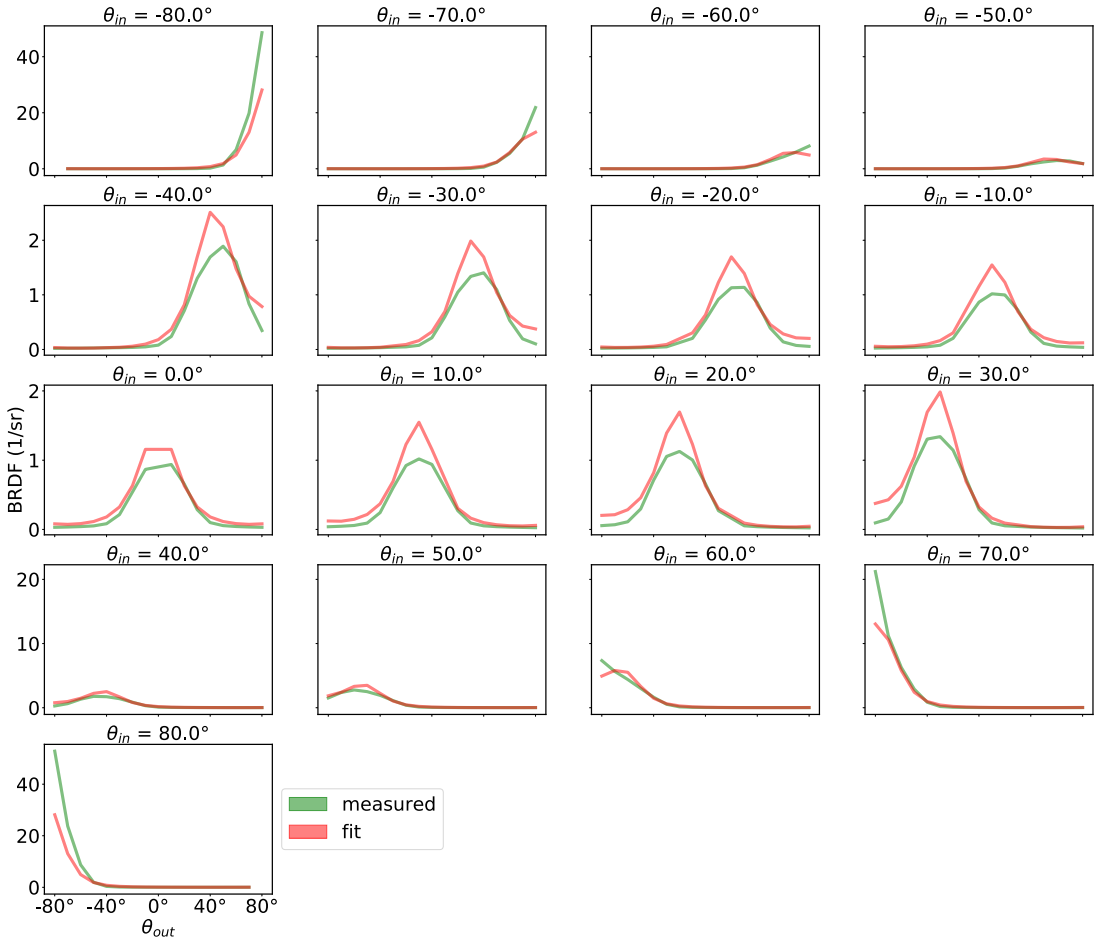
Cook-Torrance GGX

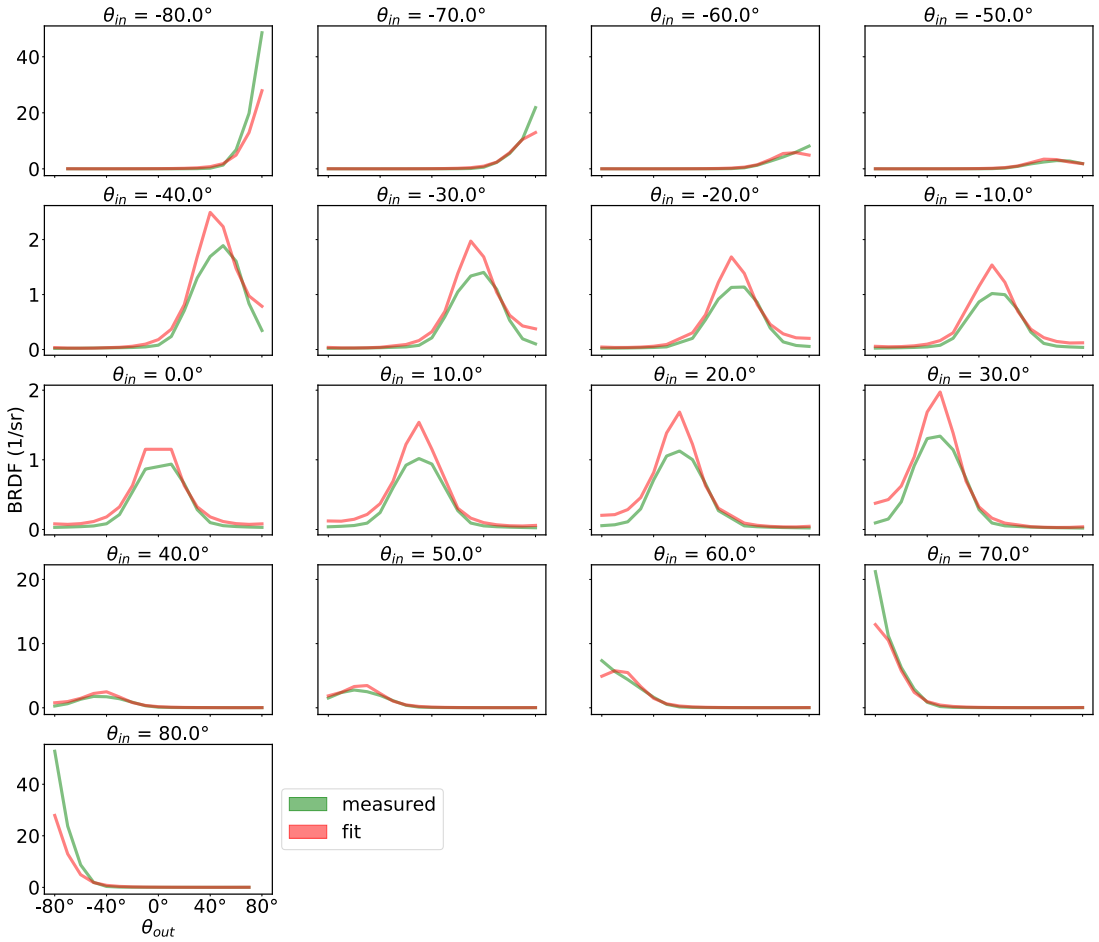


Our

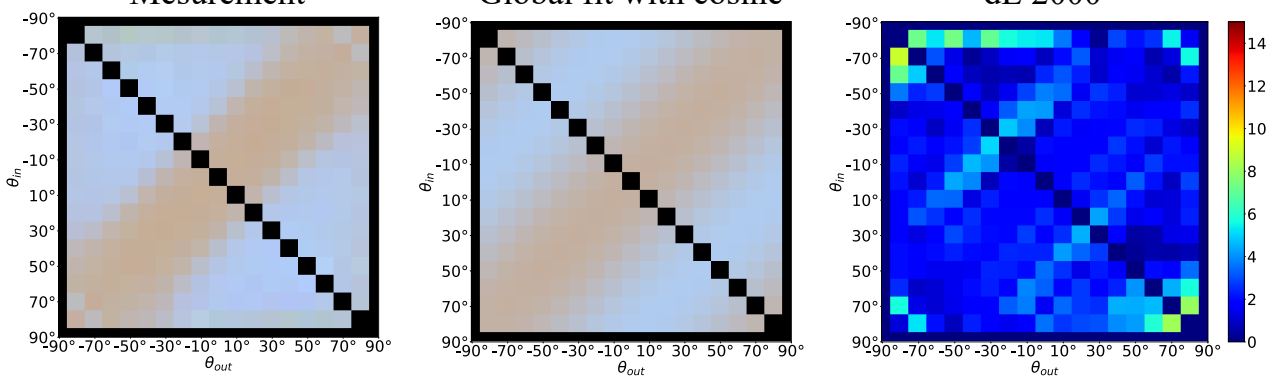


Measured vs. fitted
scatter distribution at 600 nm

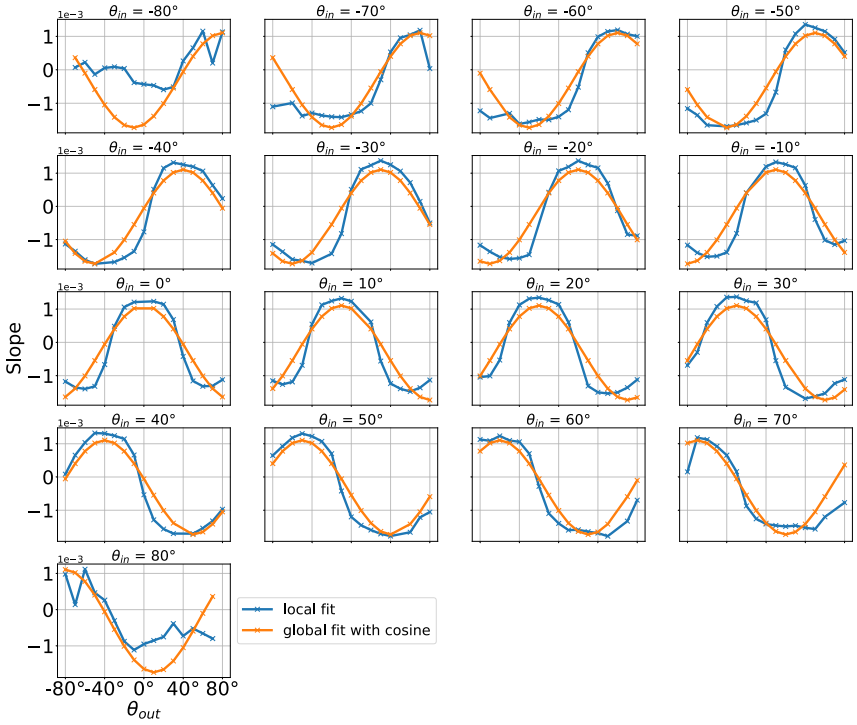




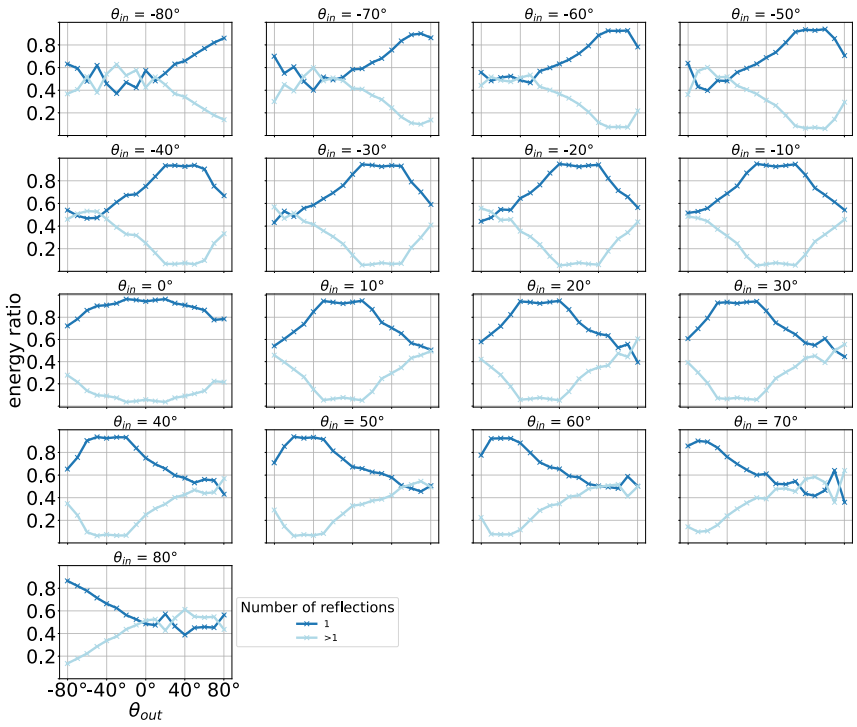
Measurement vs. global fit of normalized BRDF



Global fit of slope distribution



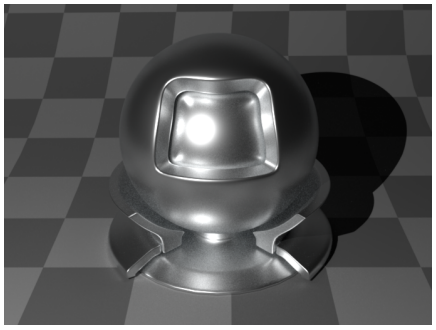
Energy ratio first vs. multiple reflections



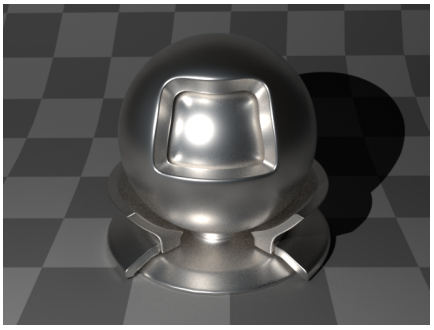
Aluminum Sample 5

Rendering
(Computed with Mitsuba 2)

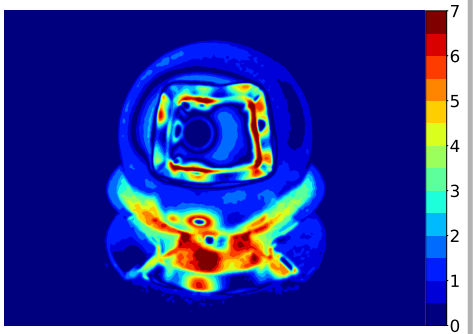
Cook-Torrance GGX



Our

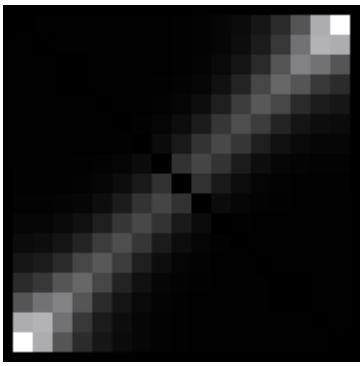


dE 2000

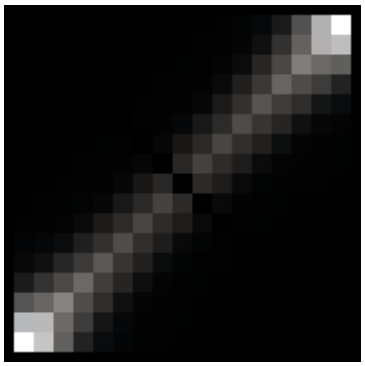


rgb image of
in-plane BRDF

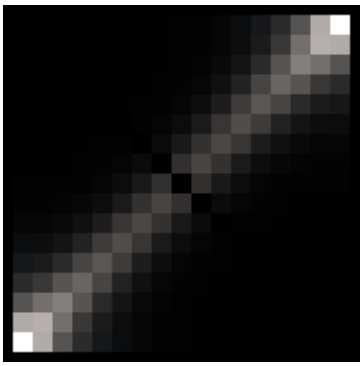
Cook-Torrance GGX



Measurement

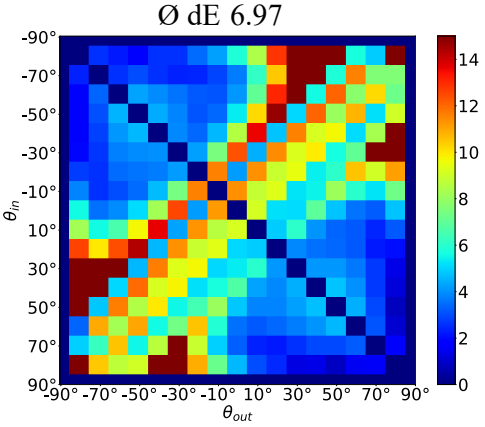


Our

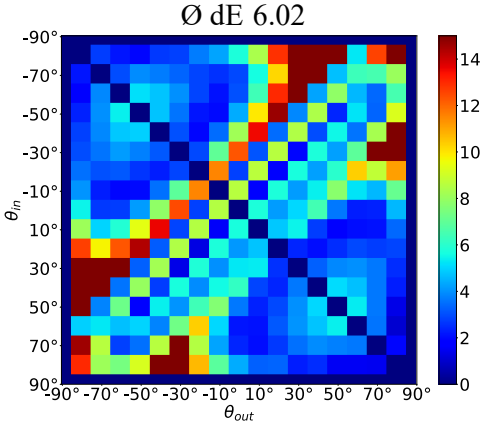


dE 2000

Ø dE 6.97



Ø dE 6.02



Fitting result

Cook-Torrance GGX

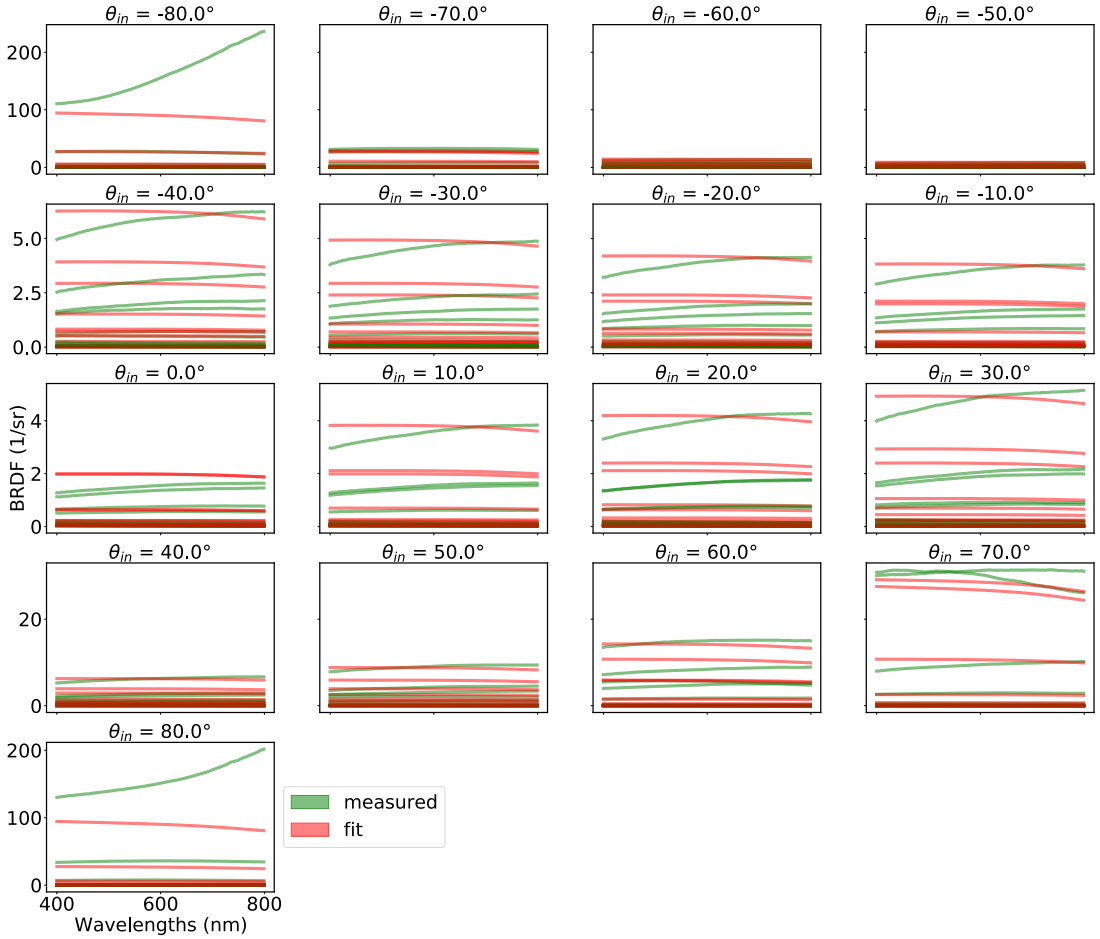
alpha = 0.1407

Our

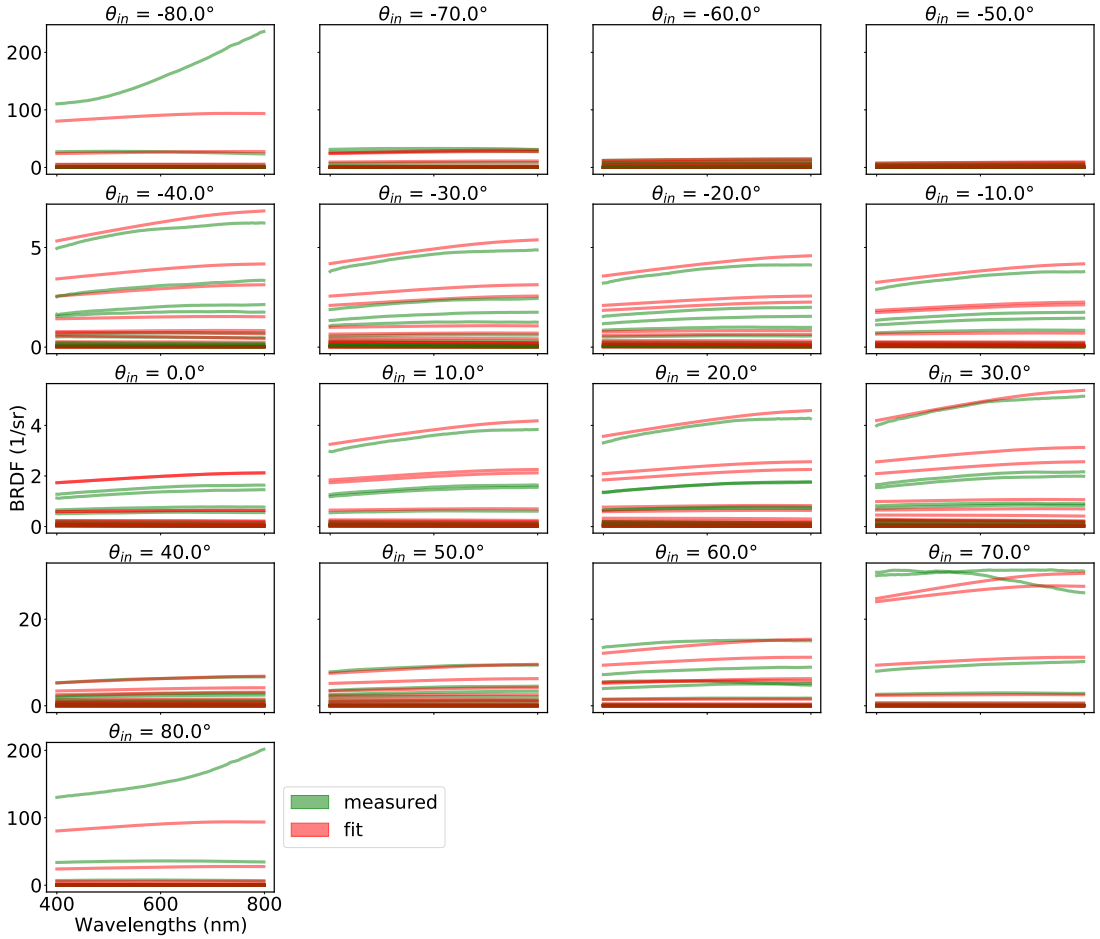
alpha = 0.1403
height = 7.67E-04
width = 6.4455

Measured vs. fitted spectra

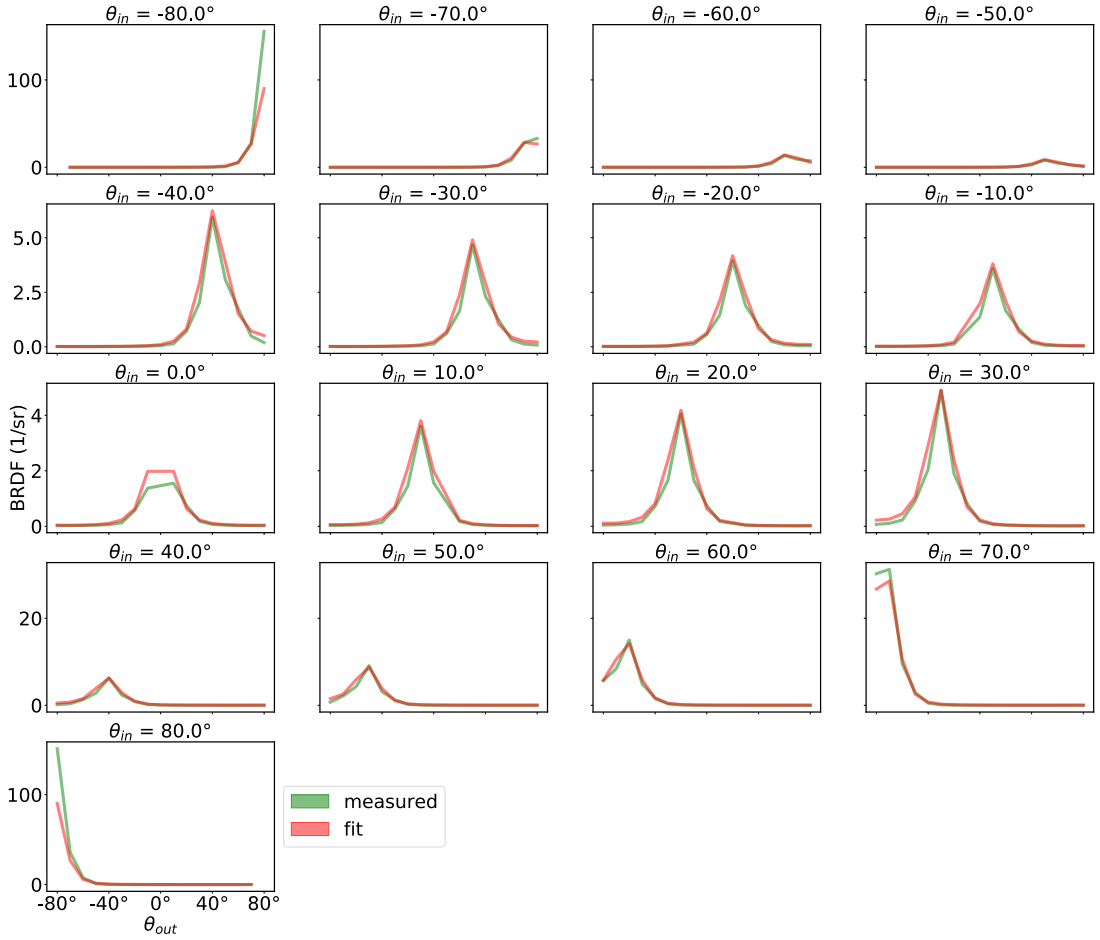
Cook-Torrance GGX

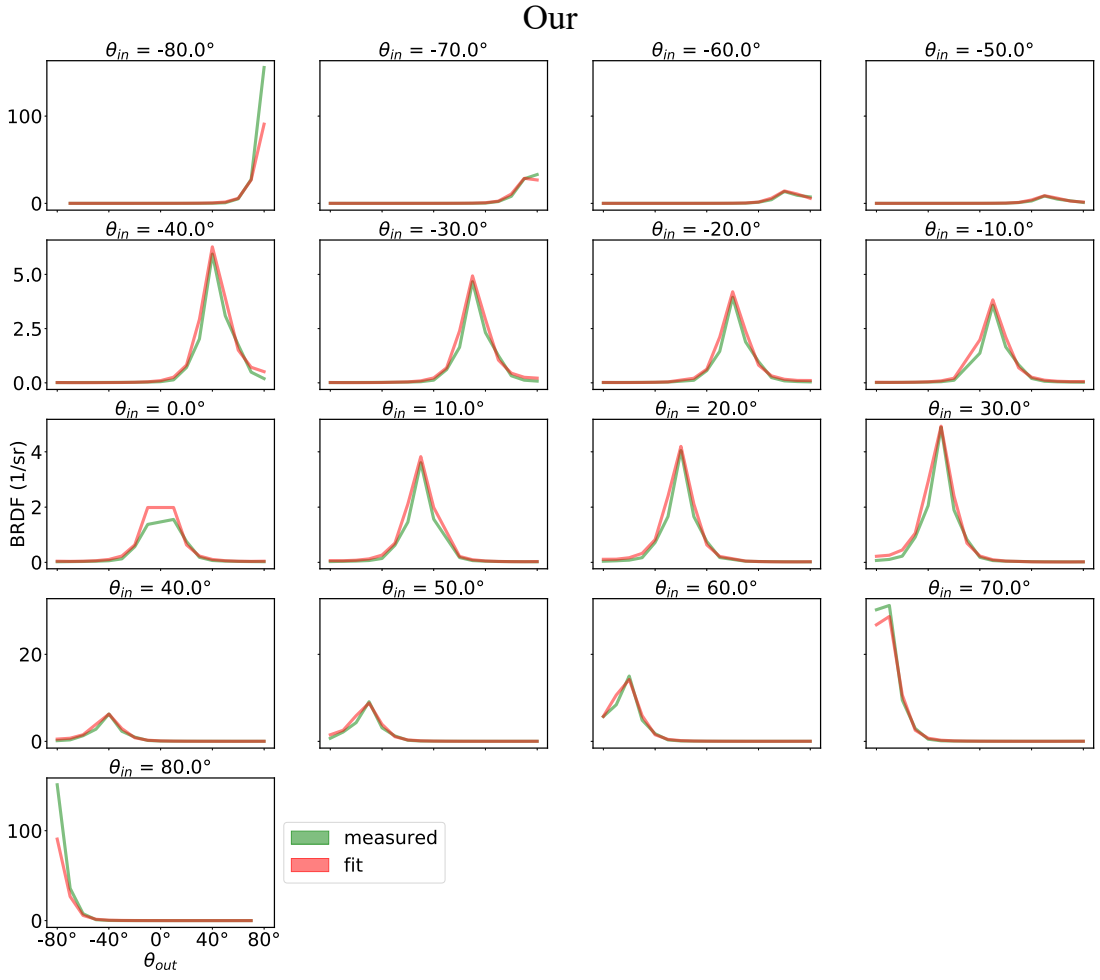


Our

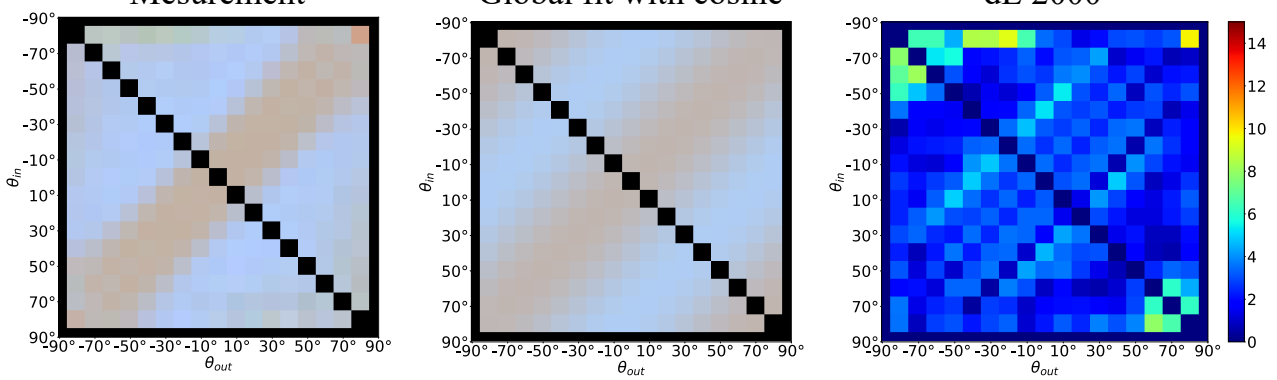


Measured vs. fitted
scatter distribution at 600 nm

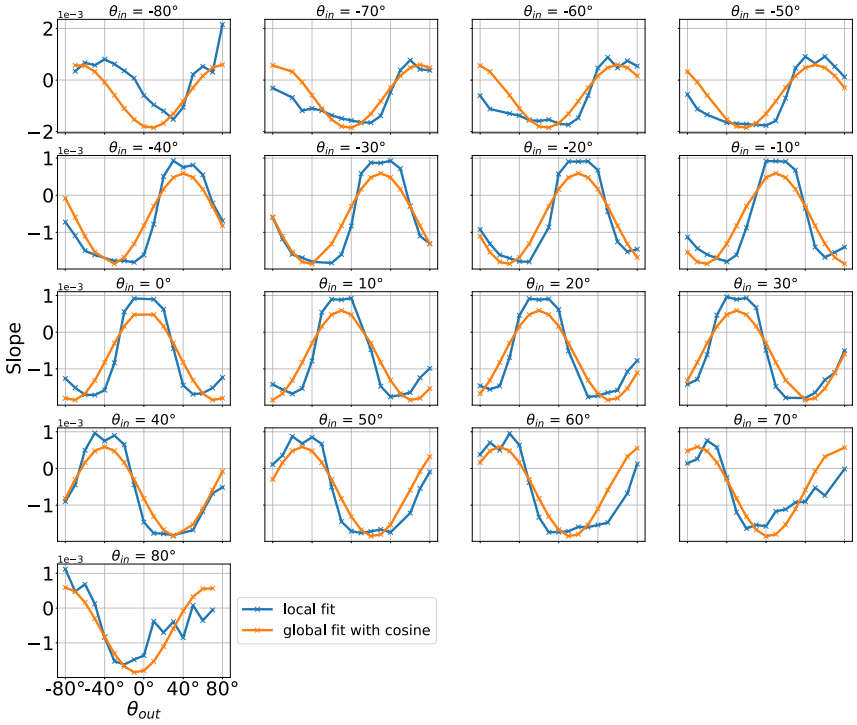




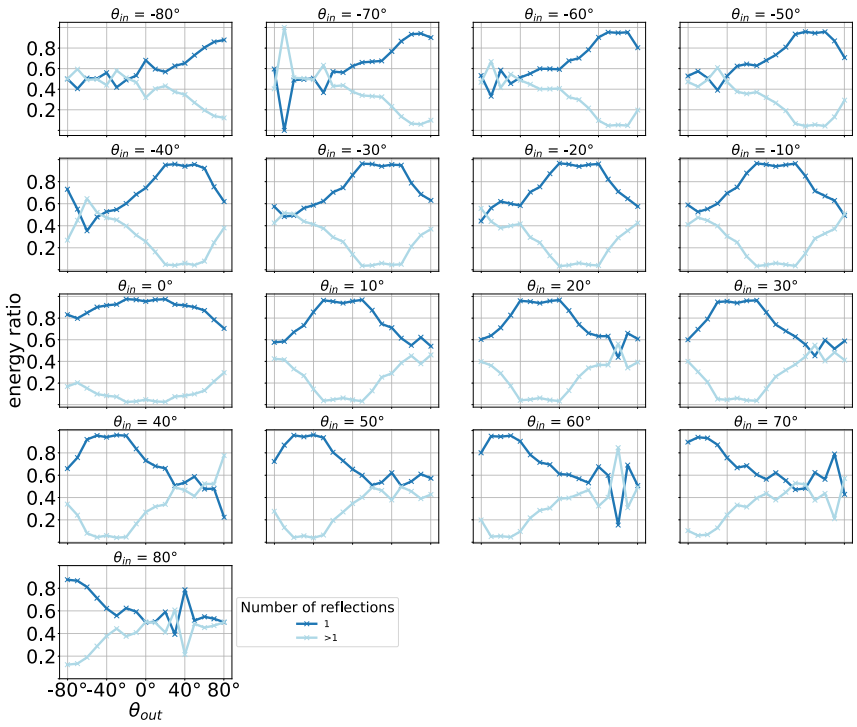
Measurement vs. global fit of normalized BRDF



Global fit of slope distribution



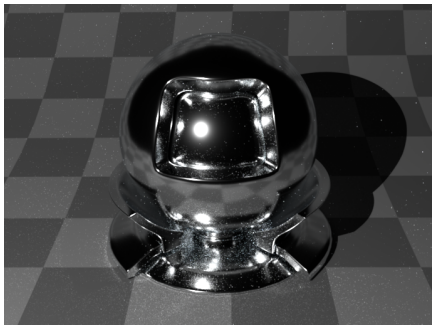
Energy ratio first vs. multiple reflections



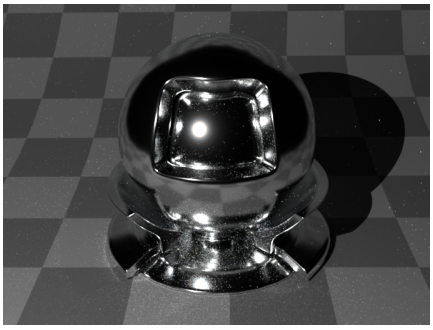
Aluminum Sample 6

Rendering
(Computed with Mitsuba 2)

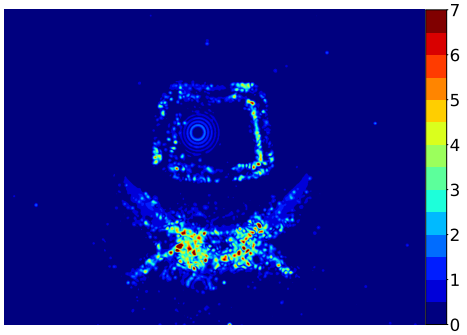
Cook-Torrance GGX



Our

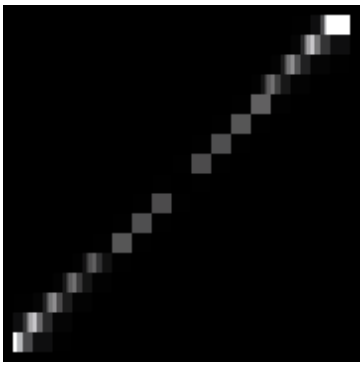


dE 2000

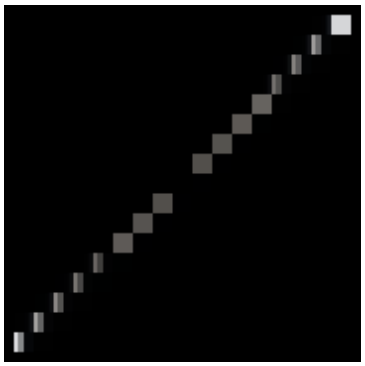


rgb image of
in-plane BRDF

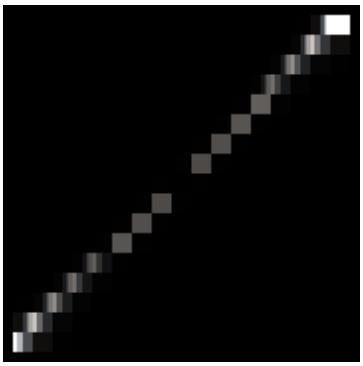
Cook-Torrance GGX



Measurement

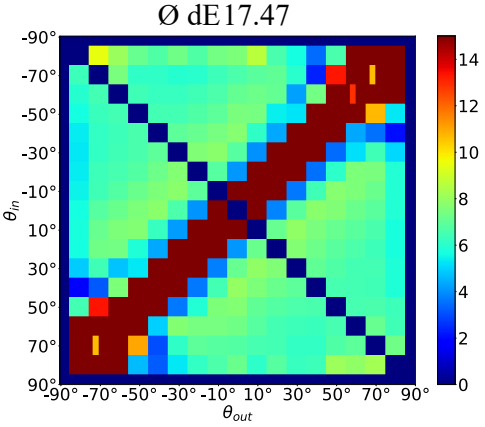


Our

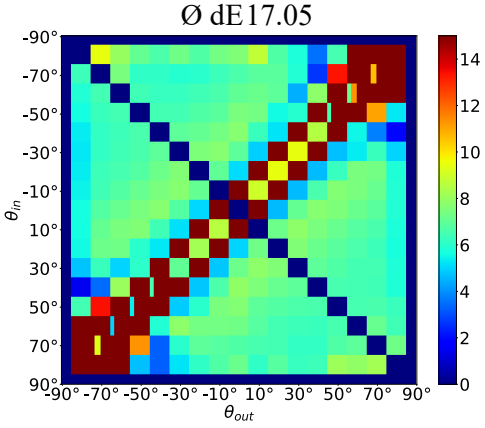


dE 2000

Ø dE17.47



Ø dE17.05



Fitting result

Cook-Torrance GGX

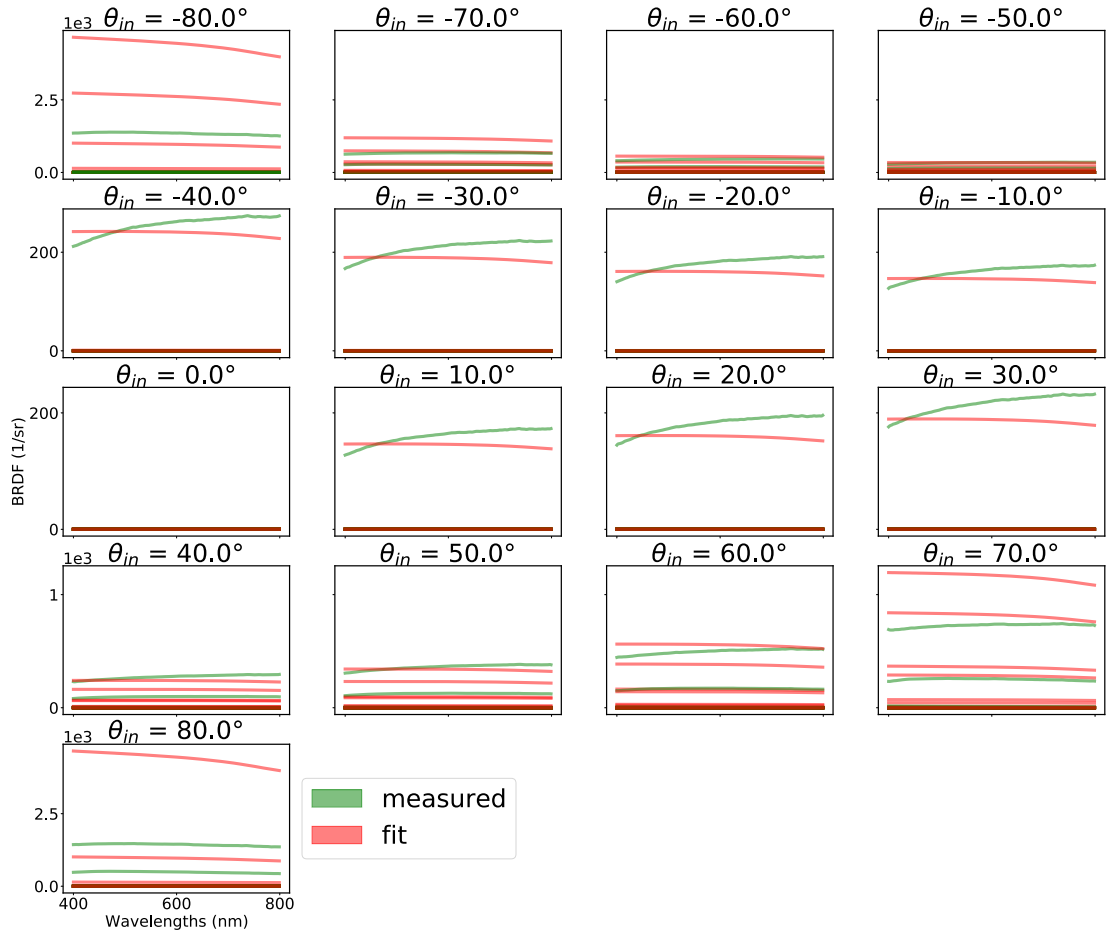
alpha = 0.0227

Our

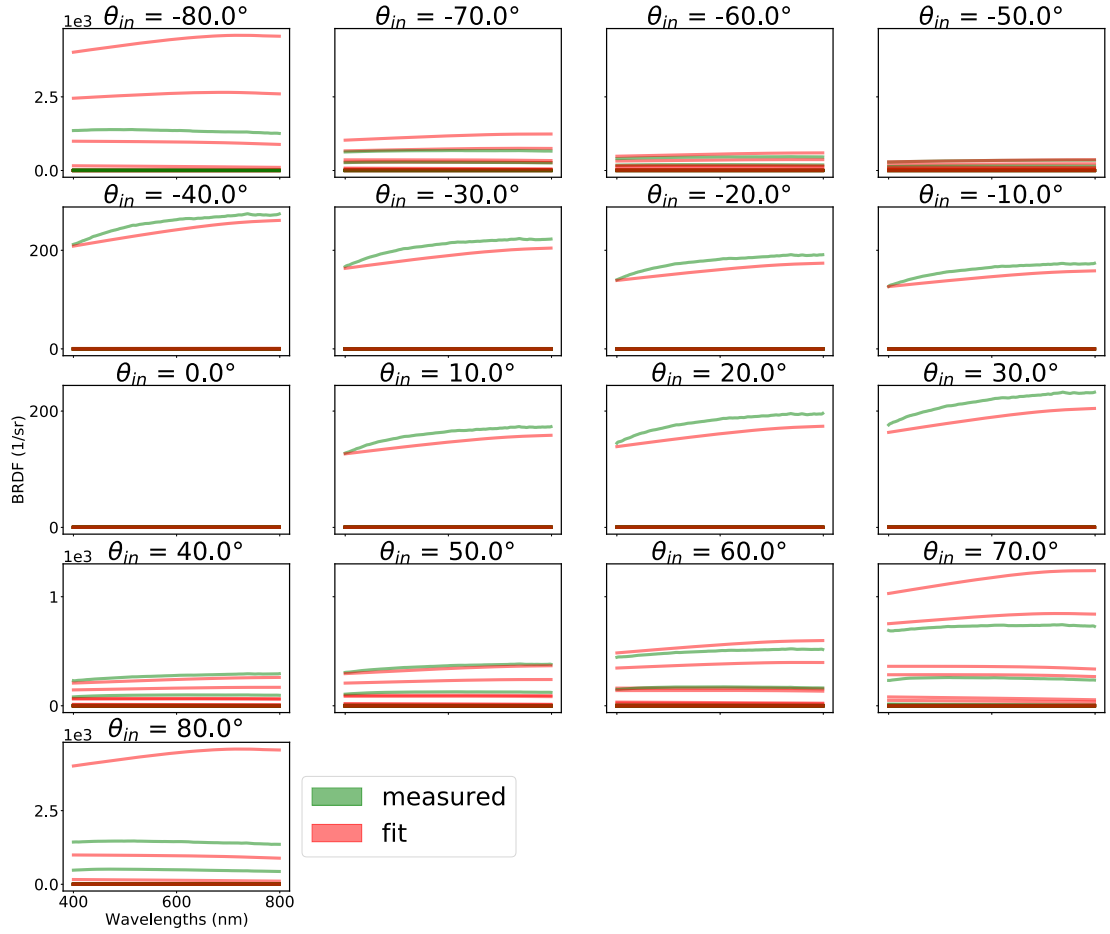
alpha = 0.0227
height = 7.04E-04
width = 66.7686

Measured vs. fitted spectra

Cook-Torrance GGX

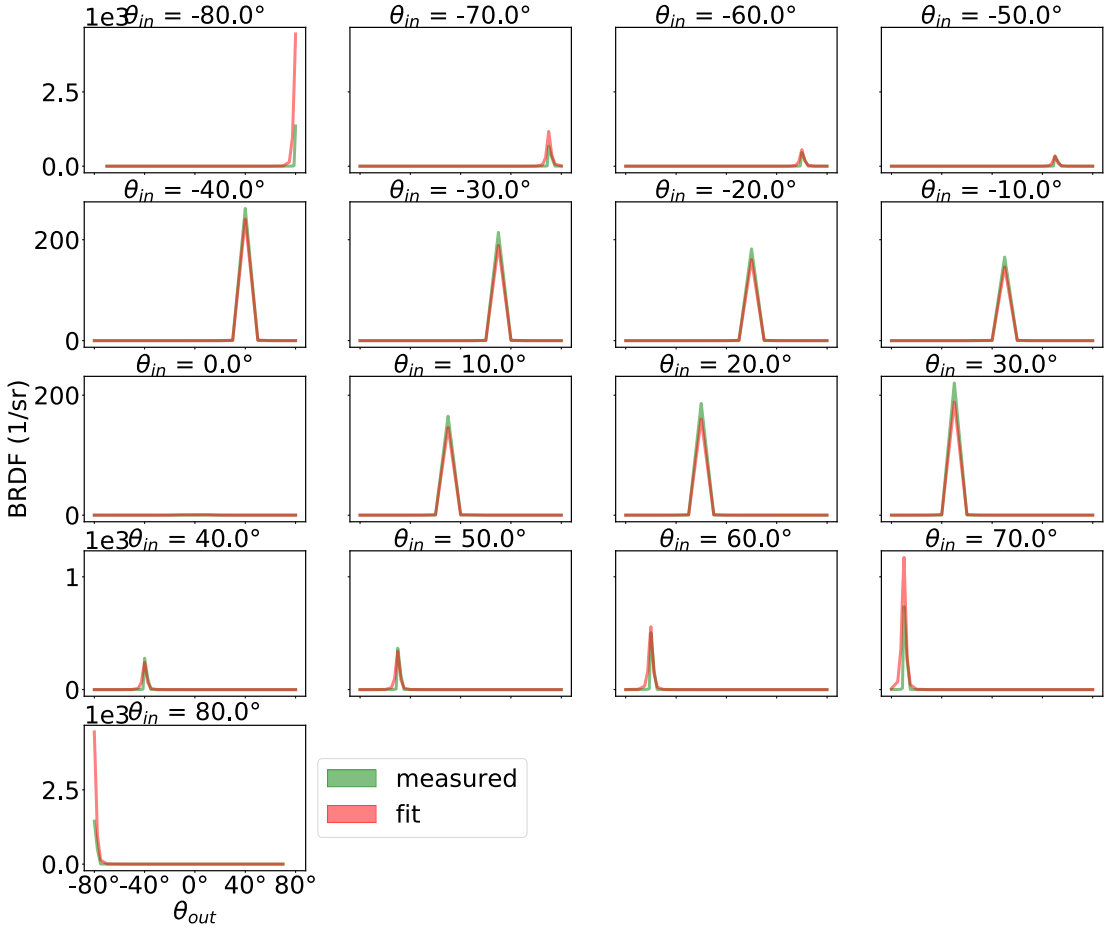


Our

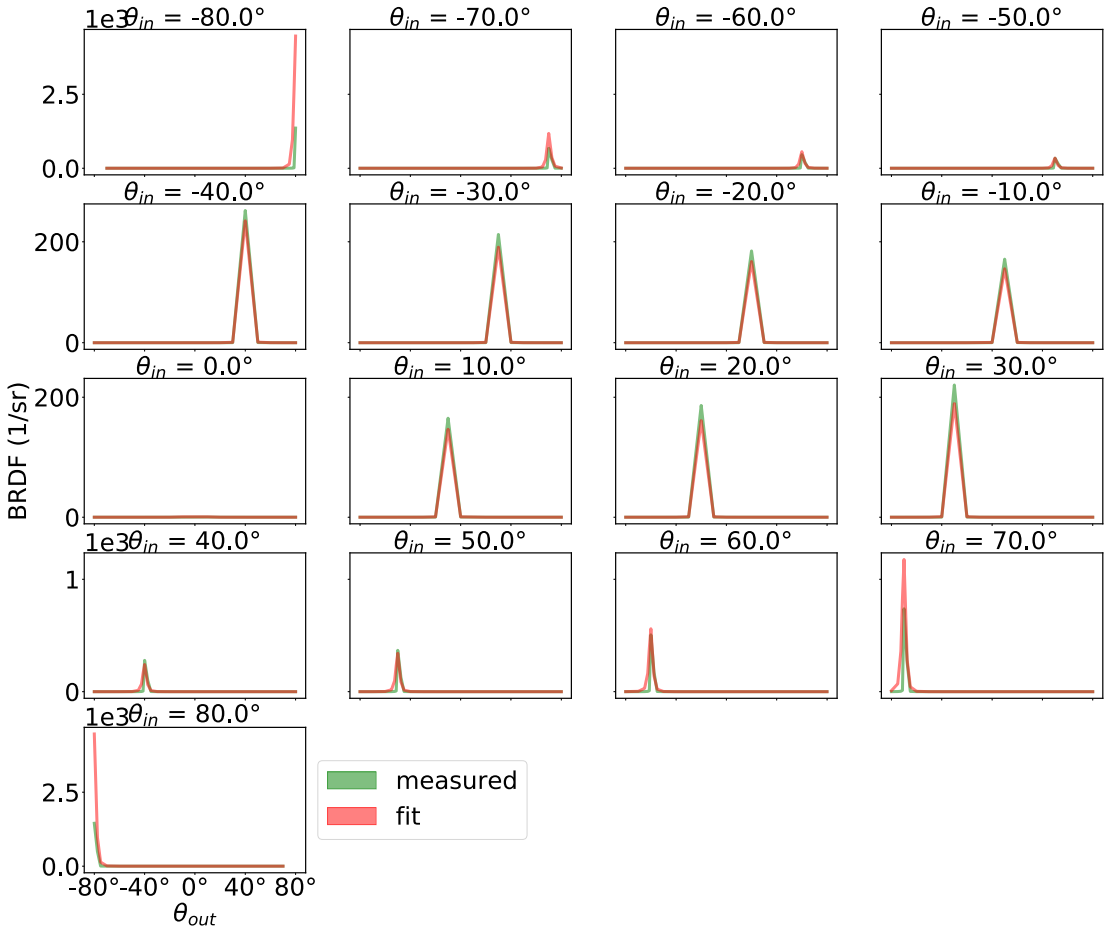


Measured vs. fitted
scatter distribution at 600 nm

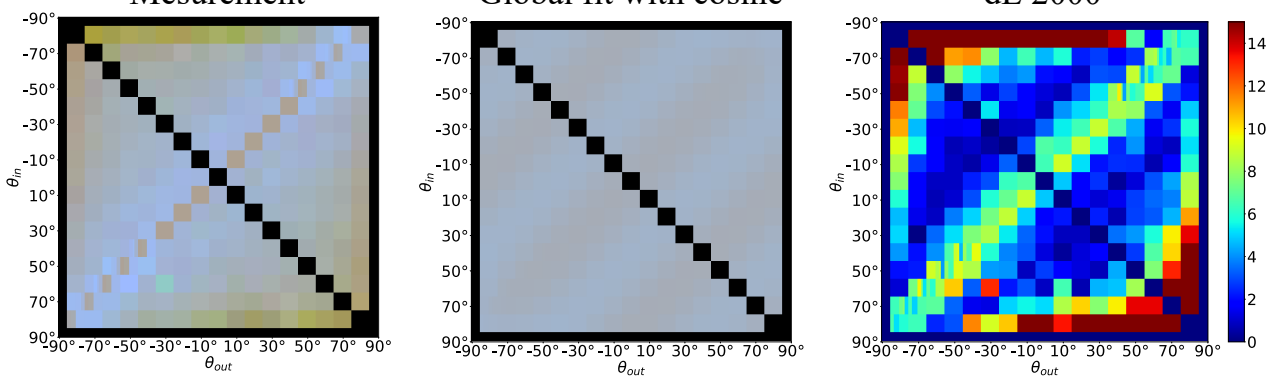
Cook-Torrance GGX



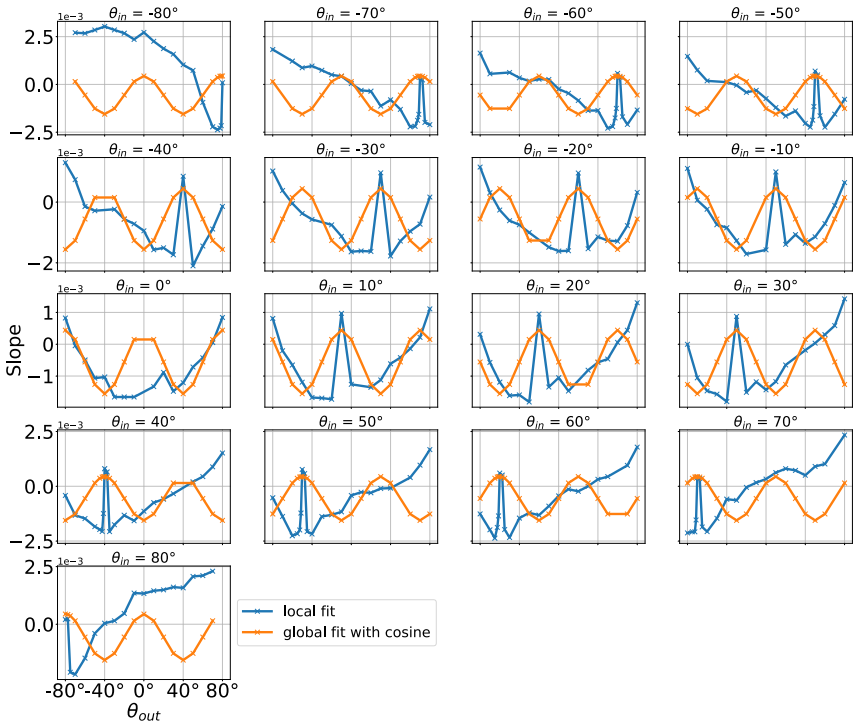
Our



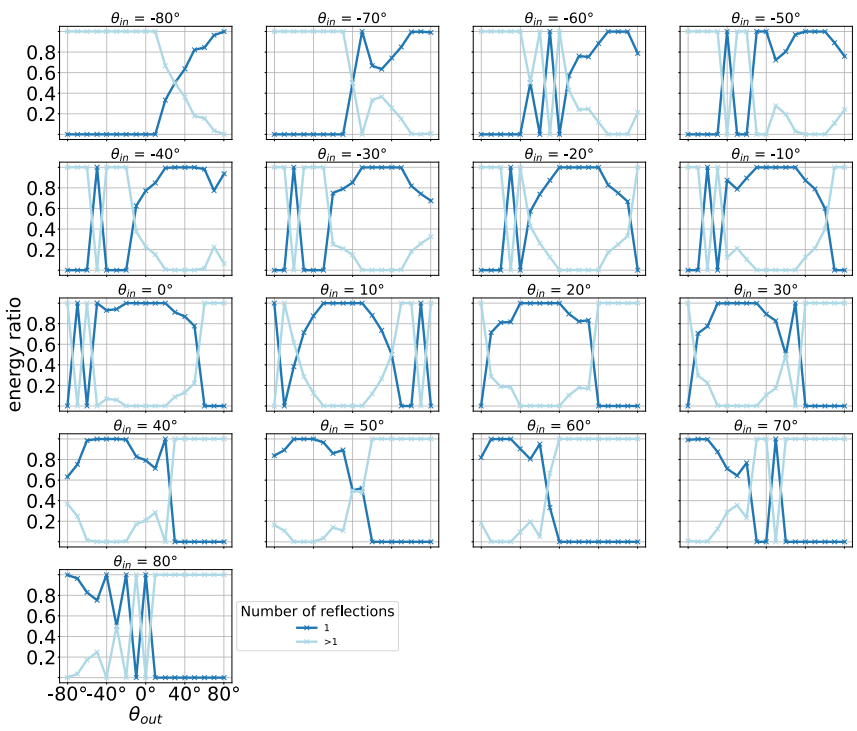
Measurement vs. global fit of normalized BRDF



Global fit of slope distribution



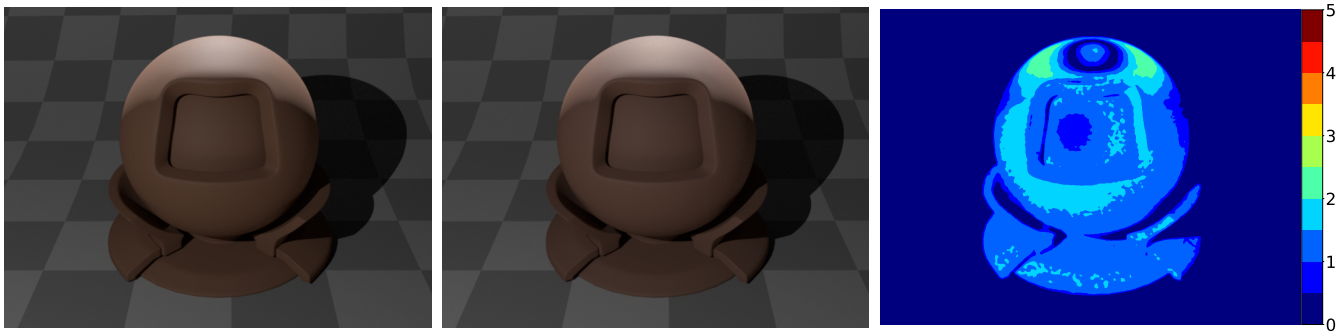
Energy ratio first vs. multiple reflections



ColorChecker - Patch 1

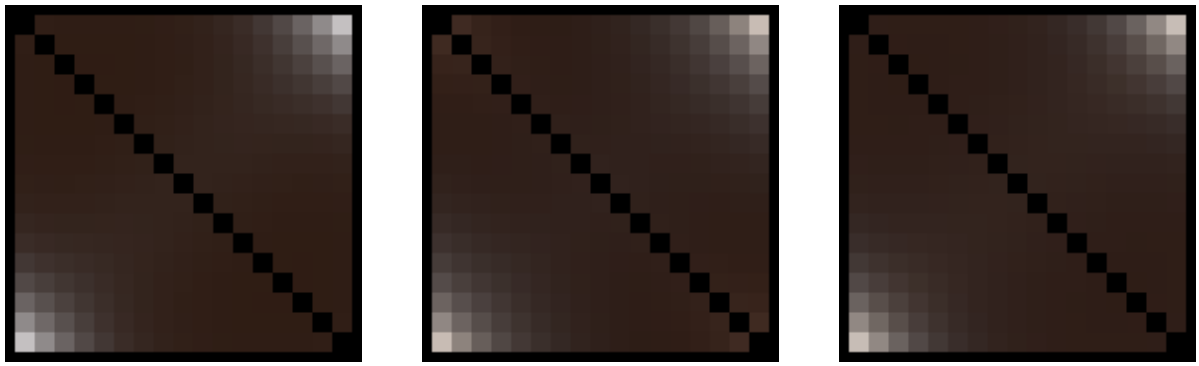
Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000



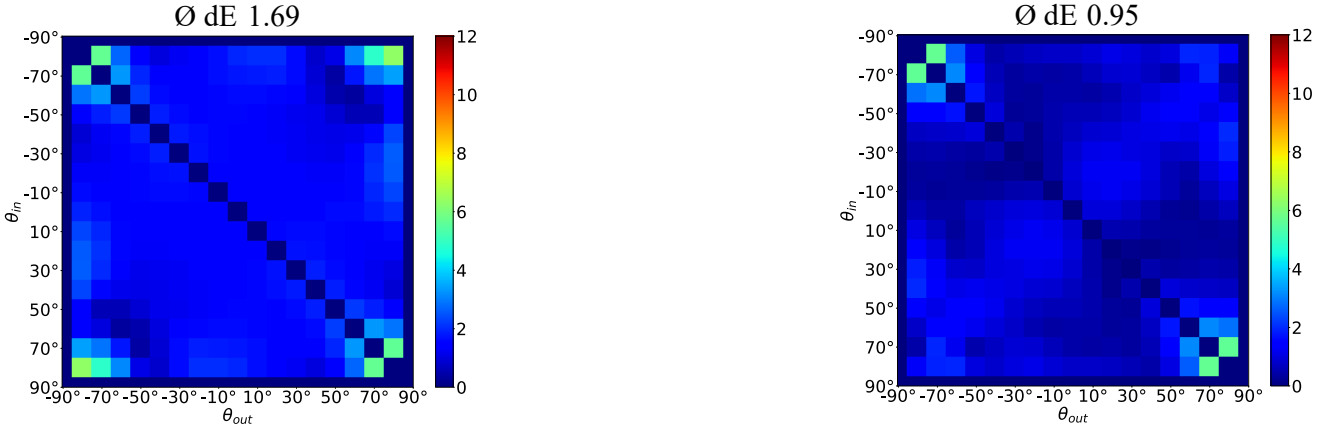
rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our



dE 2000

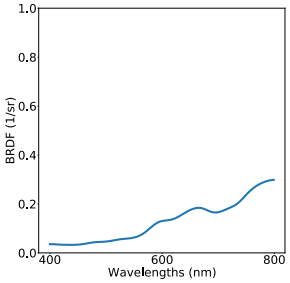
Ø dE 1.69 | Ø dE 0.95



Fitting result

Cook-Torrance GGX

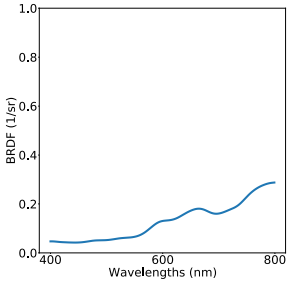
diffuse albedo



alpha = 0.4975
n_ior = 1.5041

Our

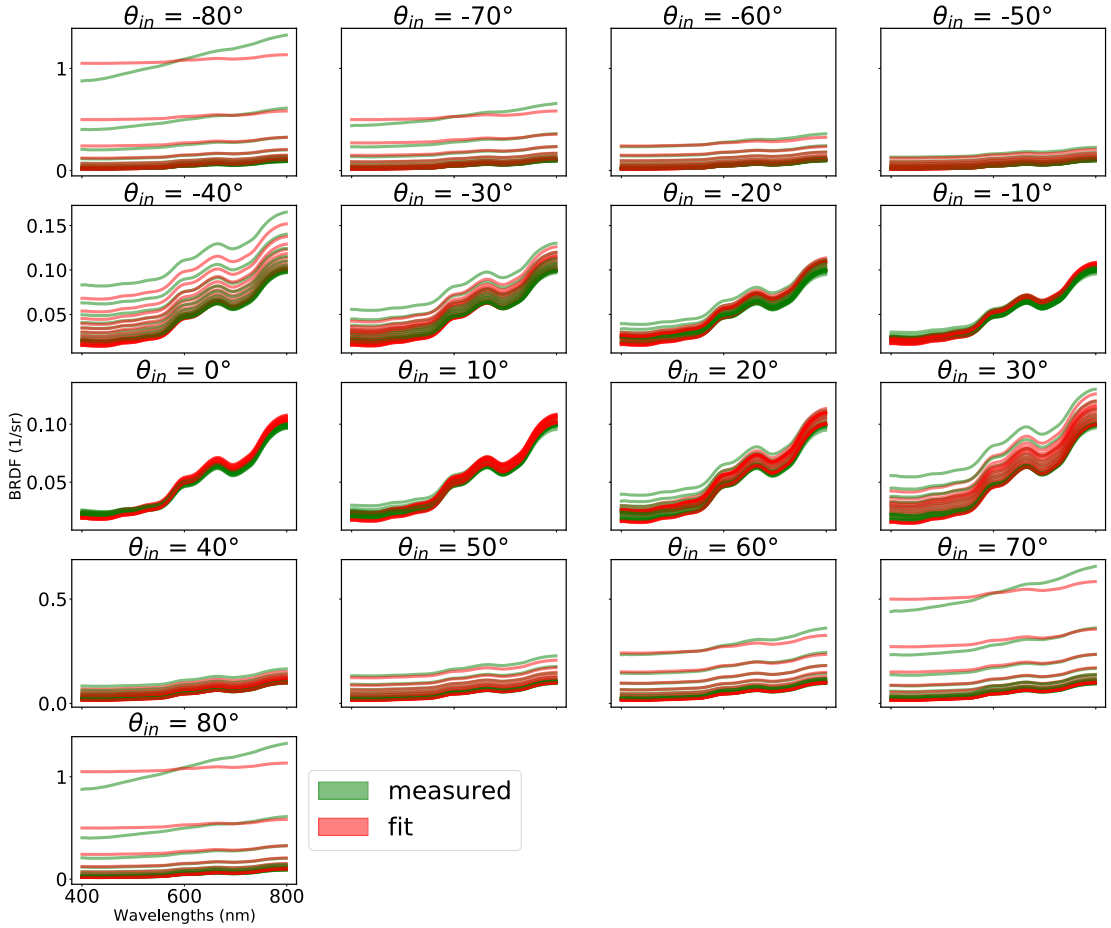
diffuse albedo



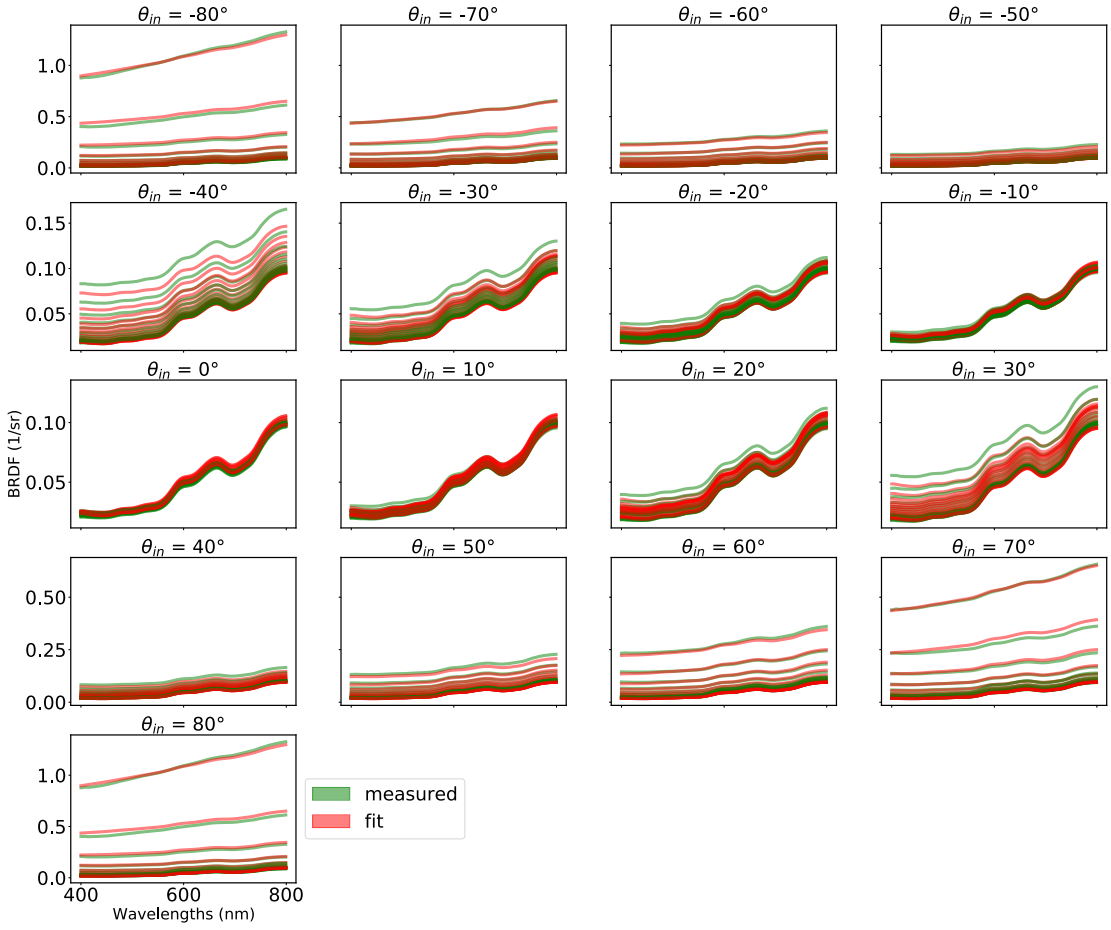
alpha = 0.4964
n_ior = 1.4996
height = 7.75E-04
width = 5.0157

Measured vs. fitted spectra

Cook-Torrance GGX

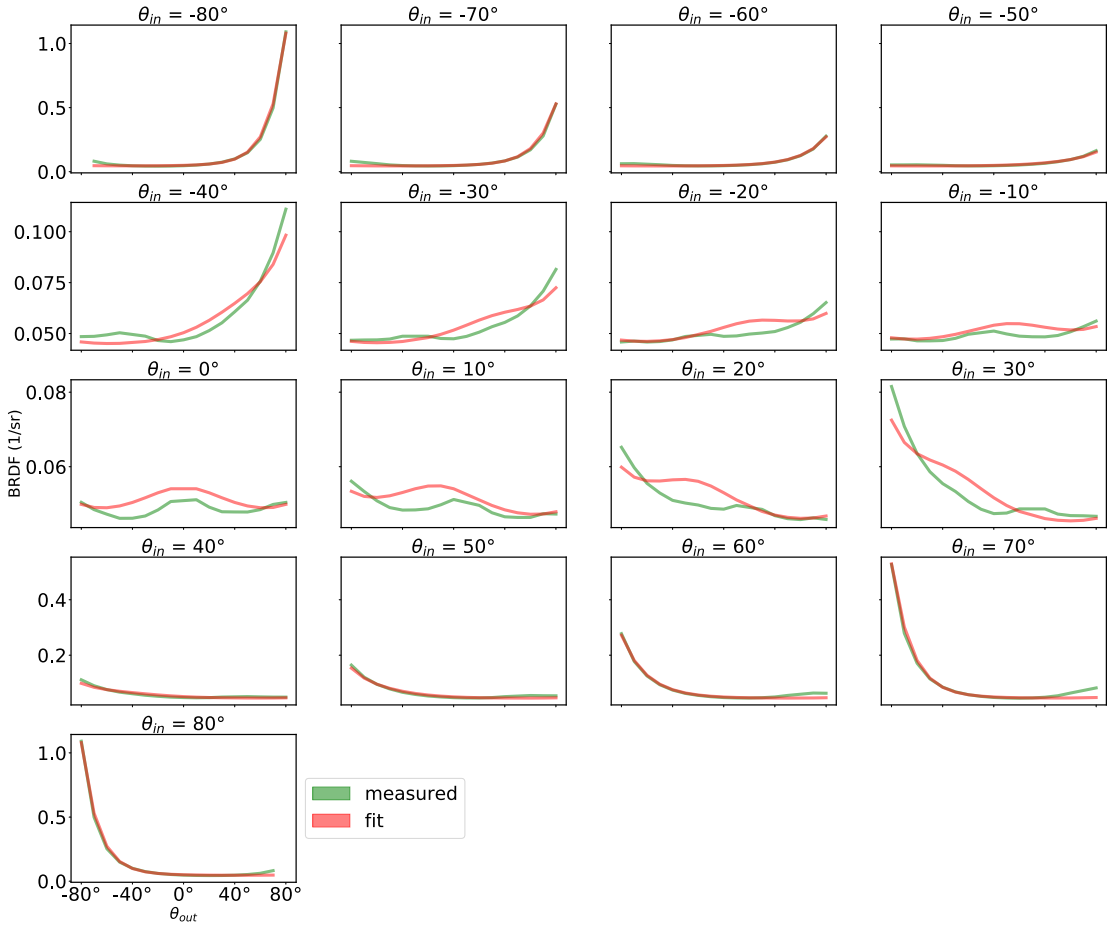


Our

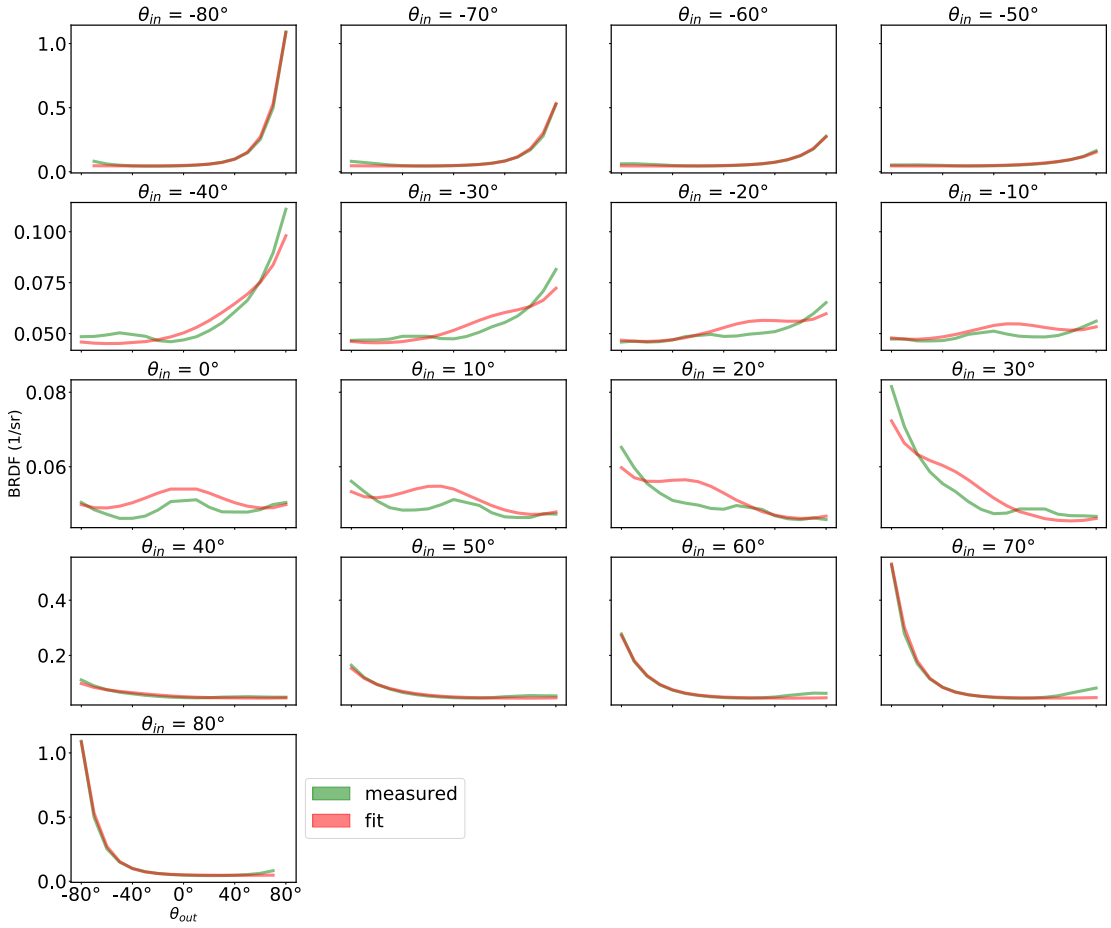


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



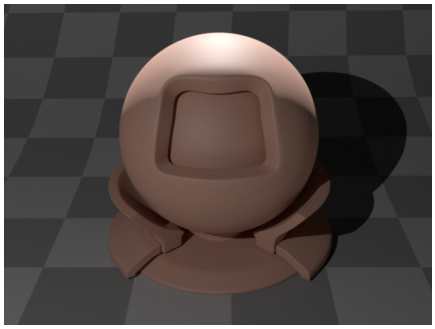
Our



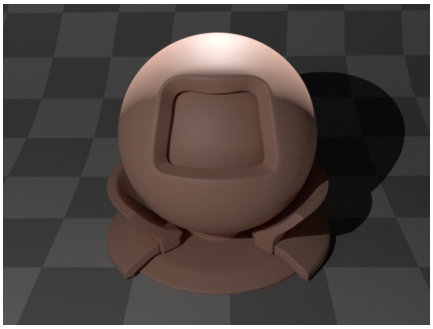
ColorChecker - Patch 2

Rendering (Computed with Mitsuba 2)

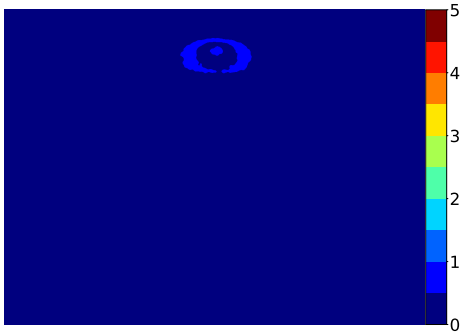
Cook-Torrance GGX



Our

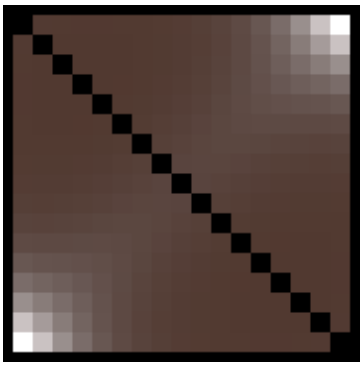


dE 2000

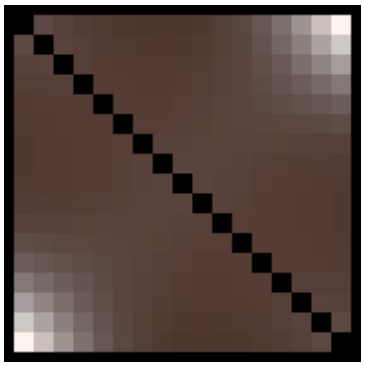


rgb image of in-plane BRDF

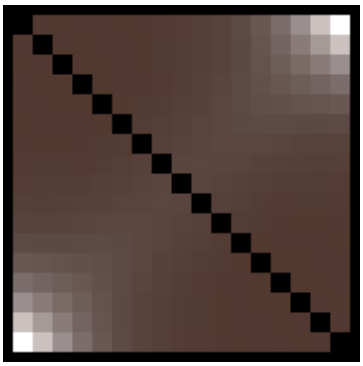
Cook-Torrance GGX



Measurement

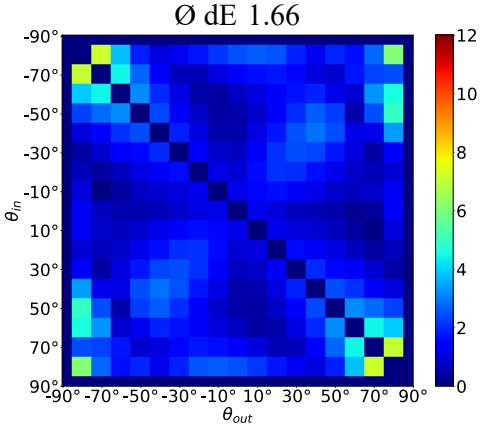


Our

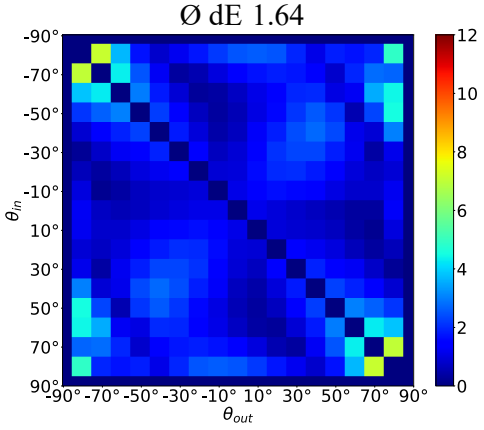


dE 2000

Ø dE 1.66



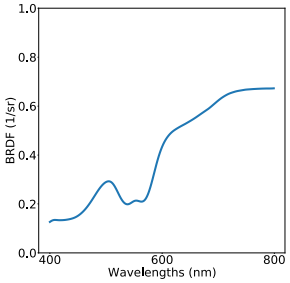
Ø dE 1.64



Fitting result

Cook-Torrance GGX

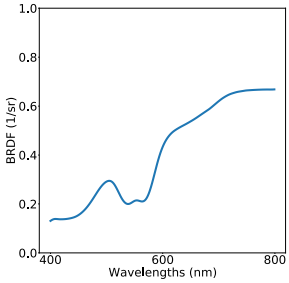
diffuse albedo



alpha = 0.4091
n_ior = 1.8891

Our

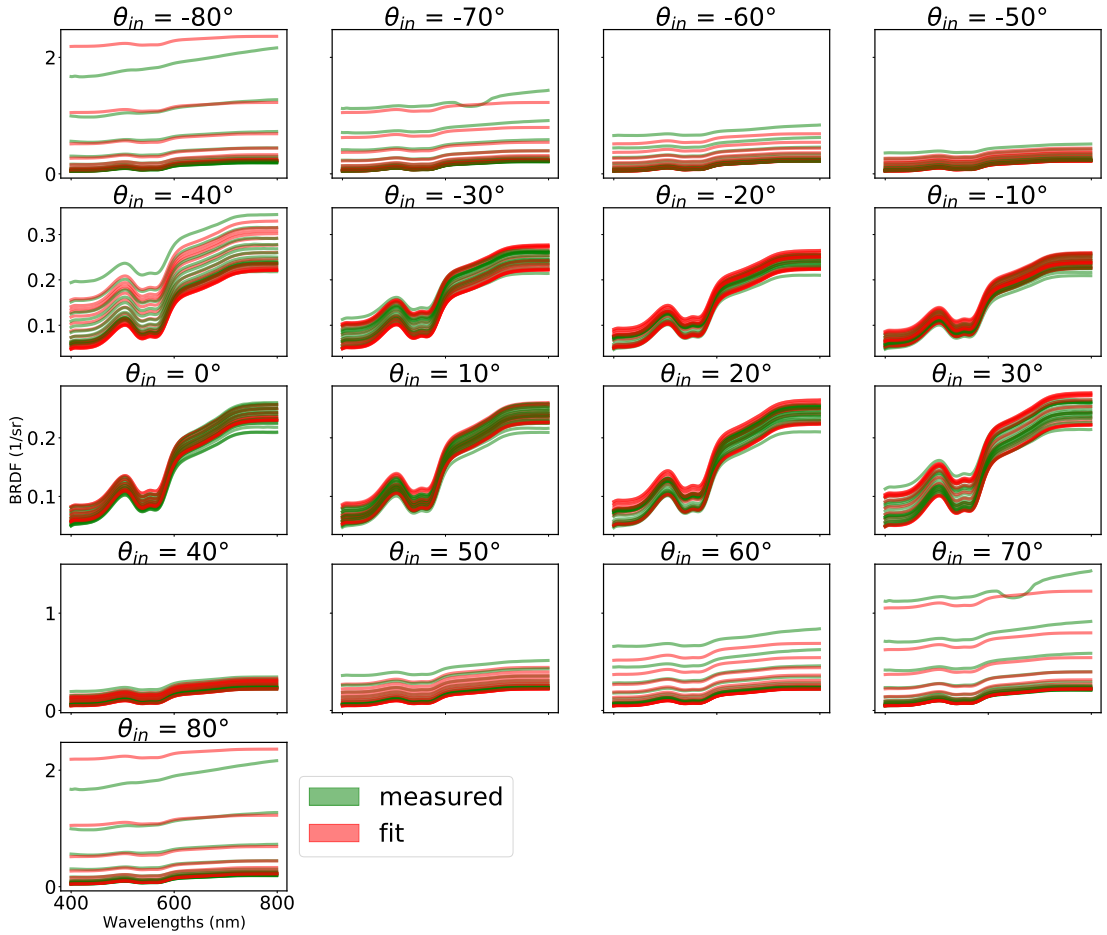
diffuse albedo



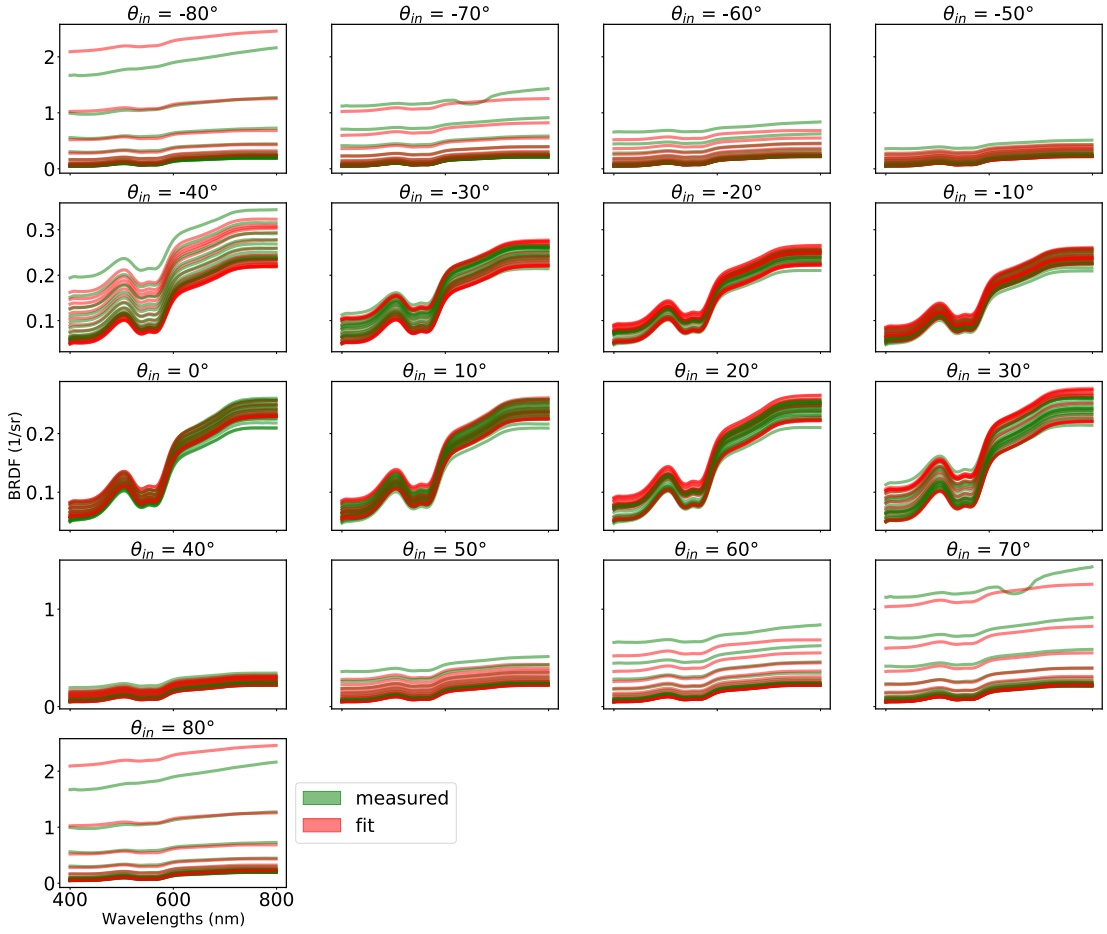
alpha = 0.4090
n_ior = 1.8887
height = 2.31E-04
width = 9.8997

Measured vs. fitted spectra

Cook-Torrance GGX

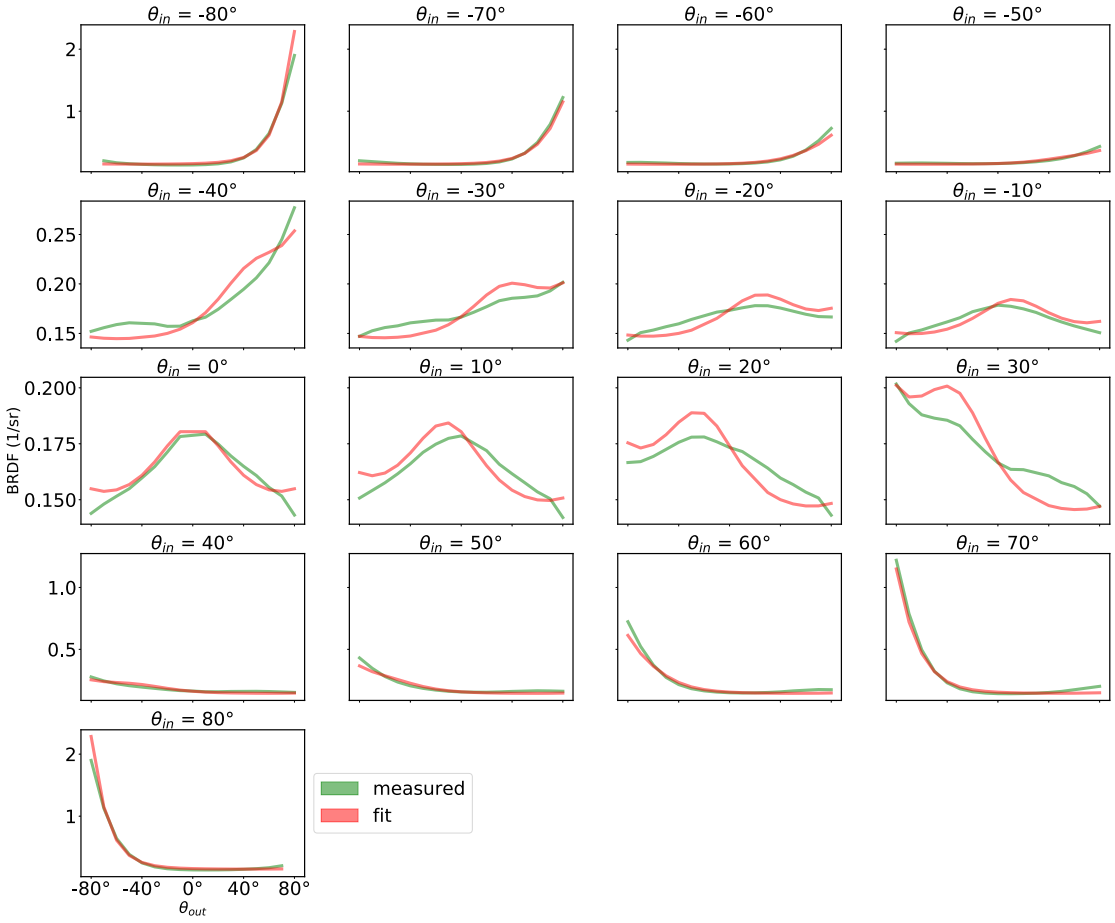


Our

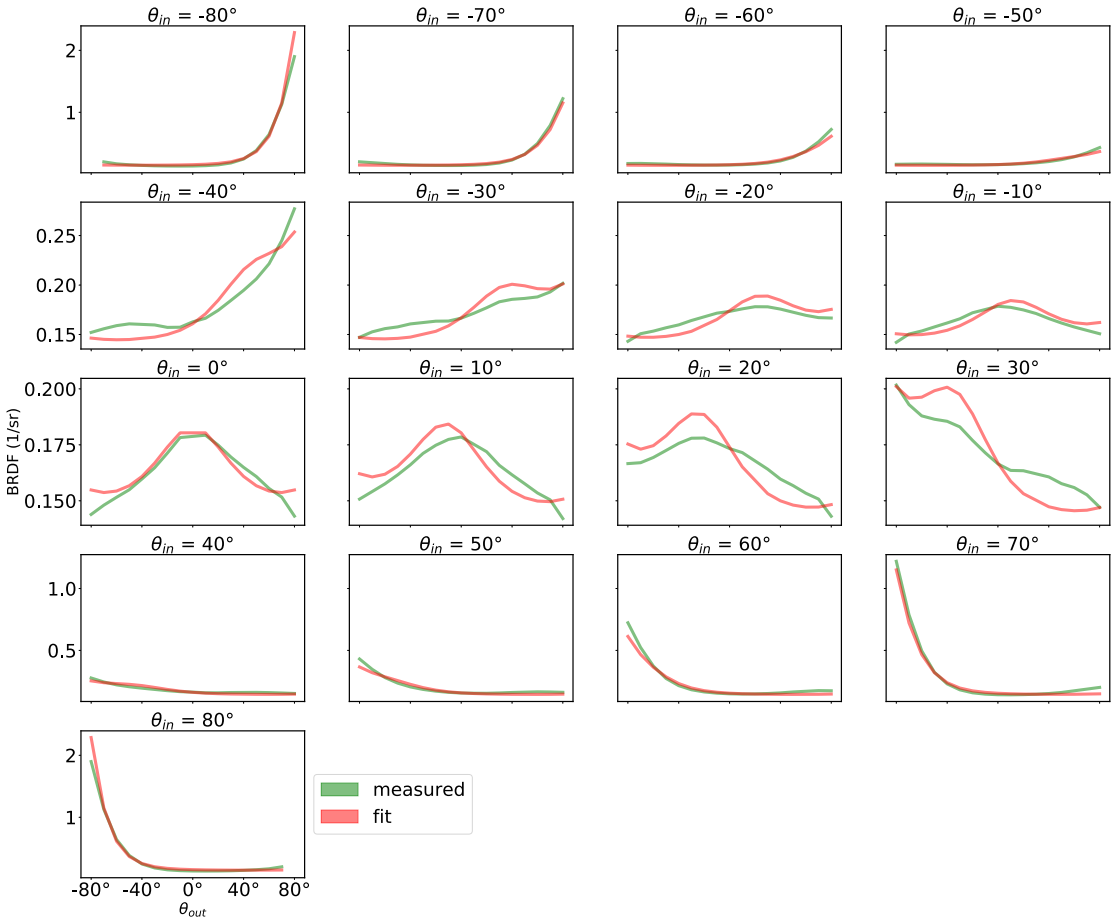


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

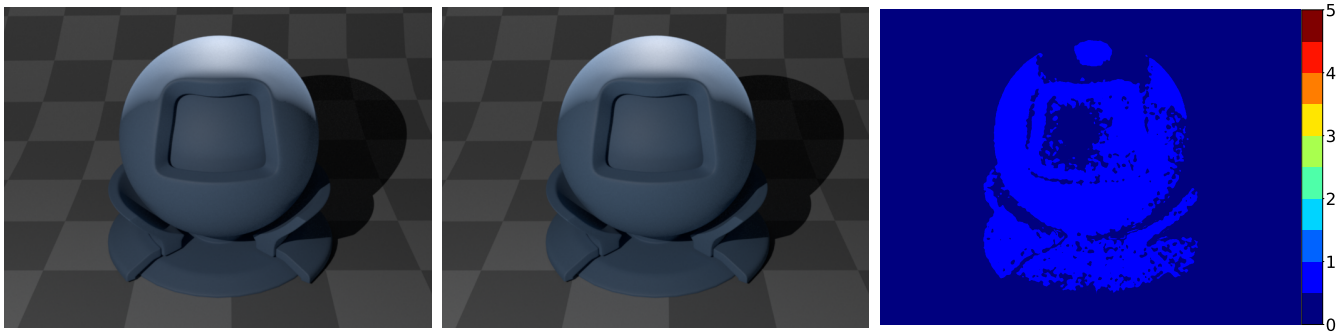


Our

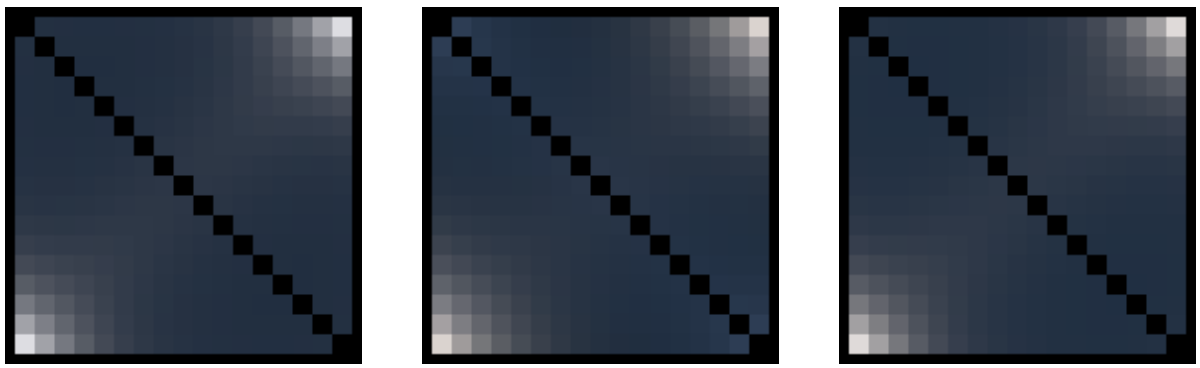


ColorChecker - Patch 3

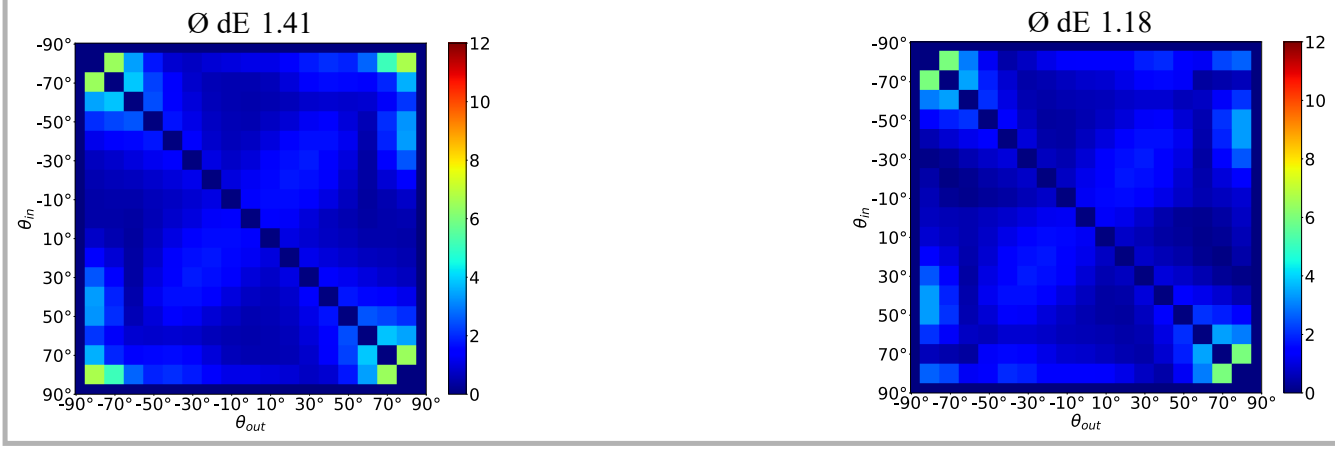
Rendering
(Computed with Mitsuba 2)



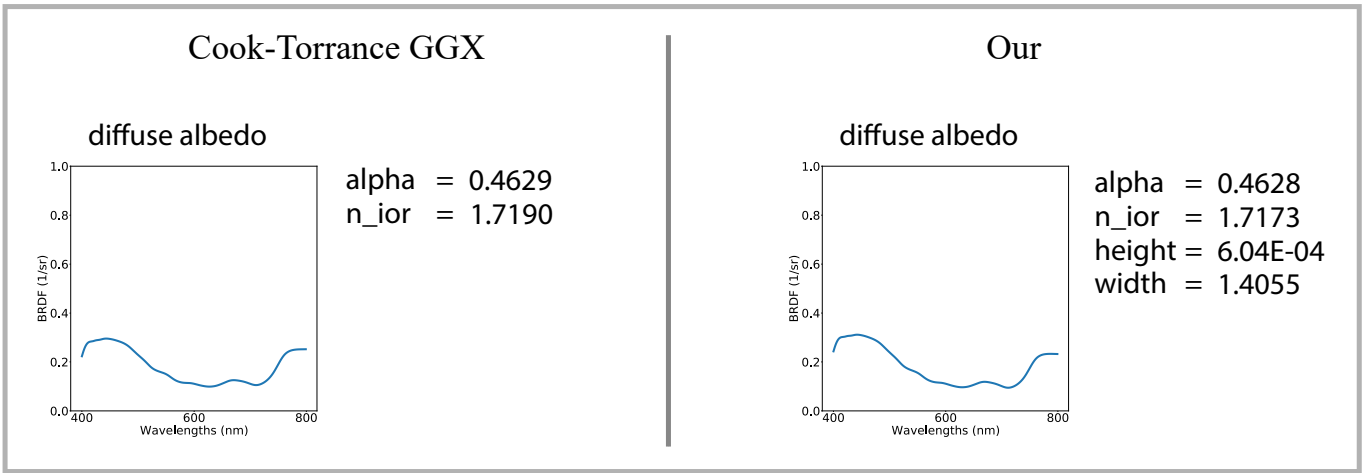
rgb image of
in-plane BRDF



dE 2000

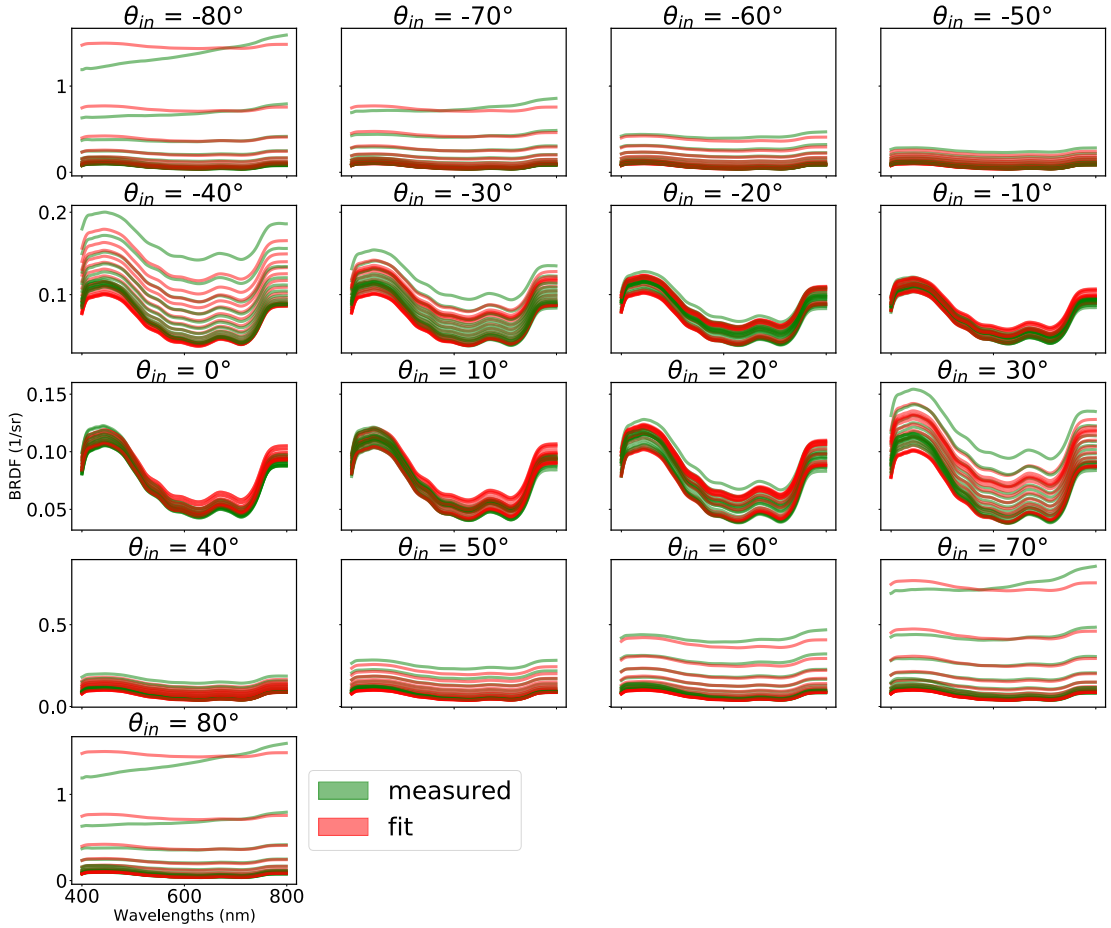


Fitting result

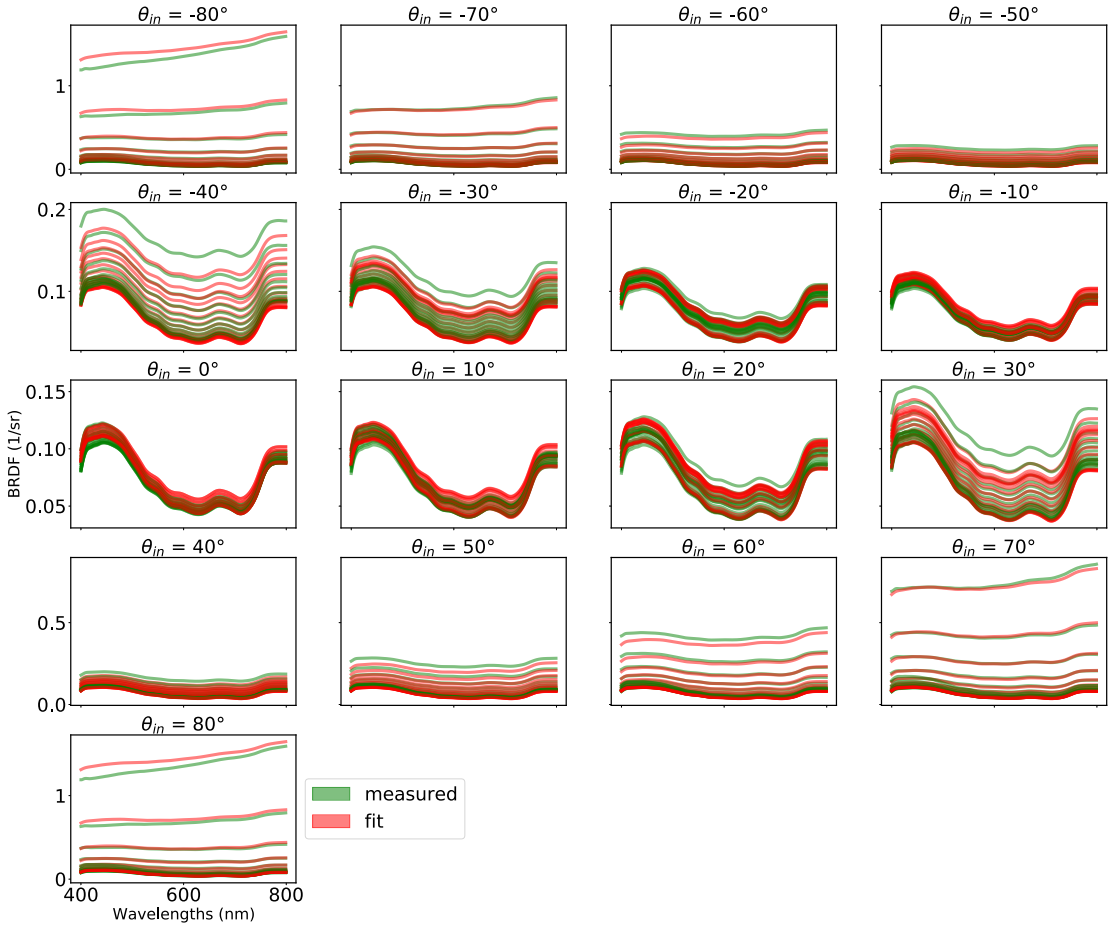


Measured vs. fitted spectra

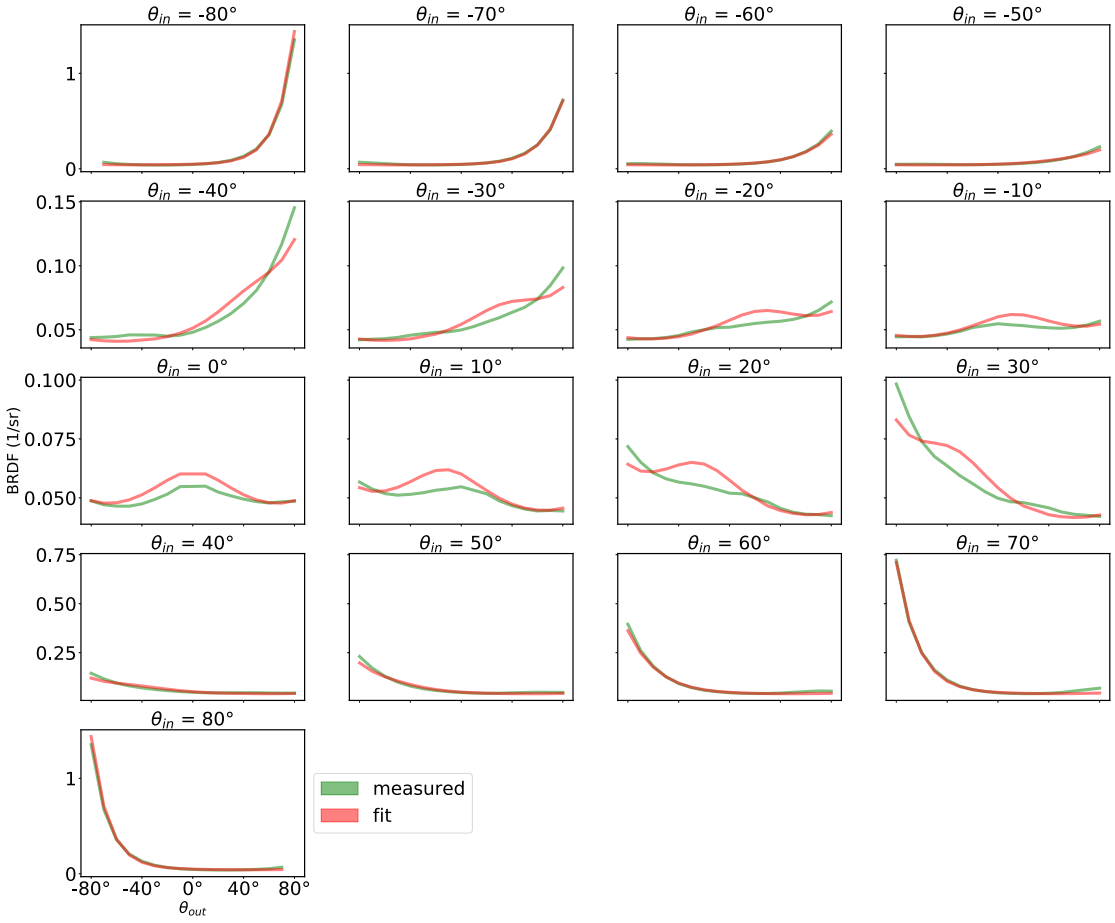
Cook-Torrance GGX

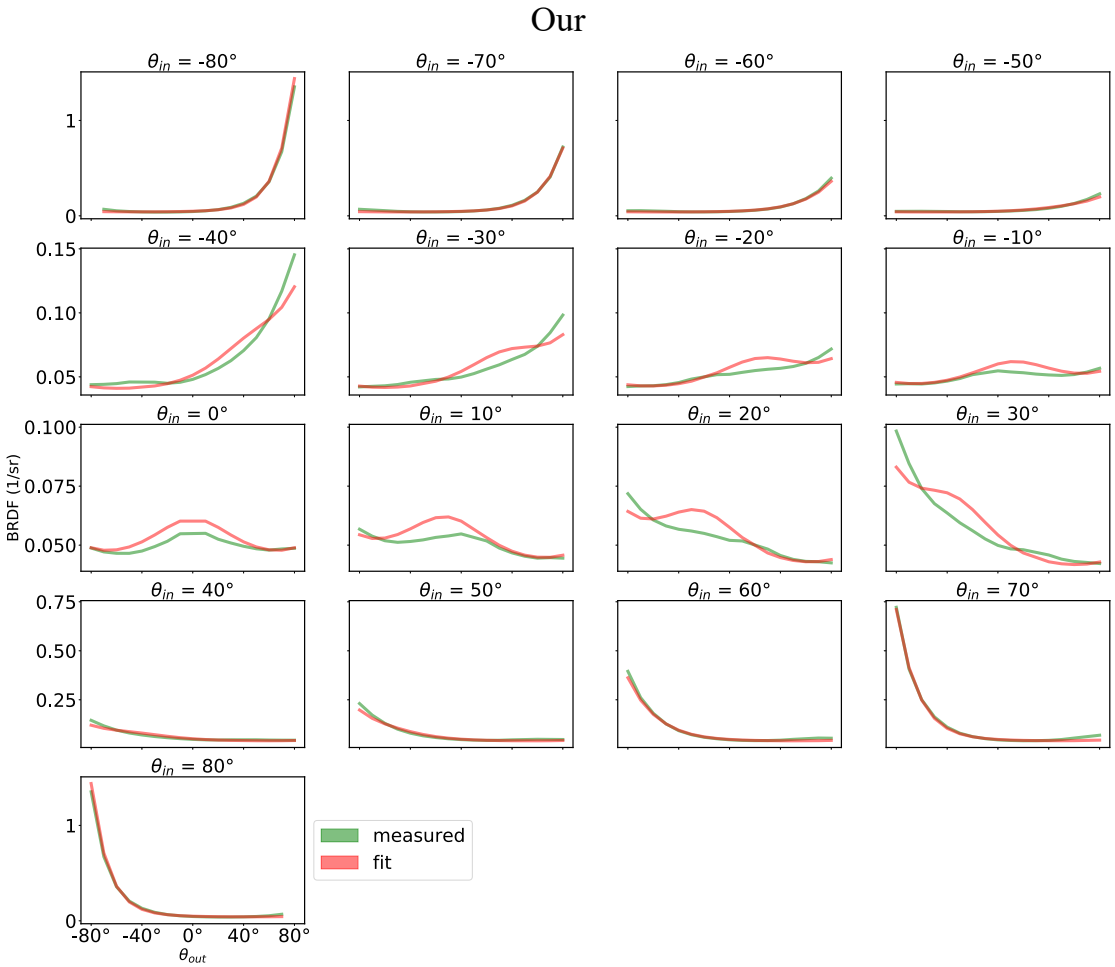


Our



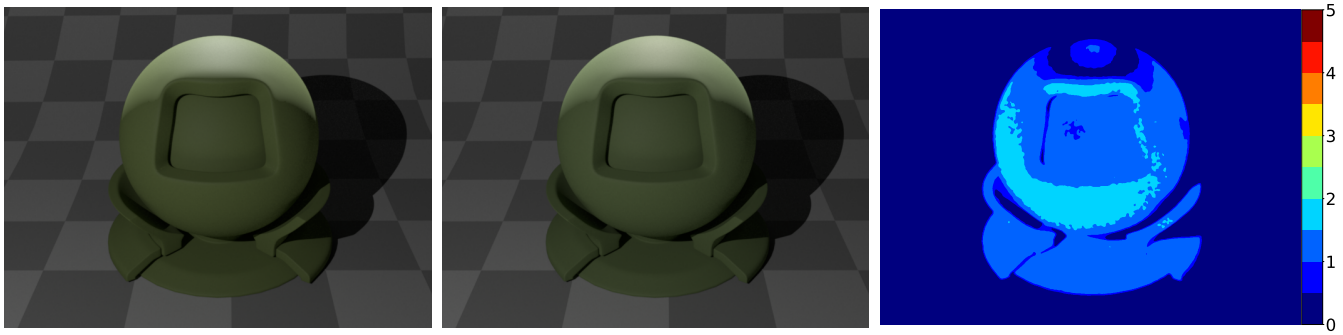
Measured vs. fitted
scatter distribution at 600 nm



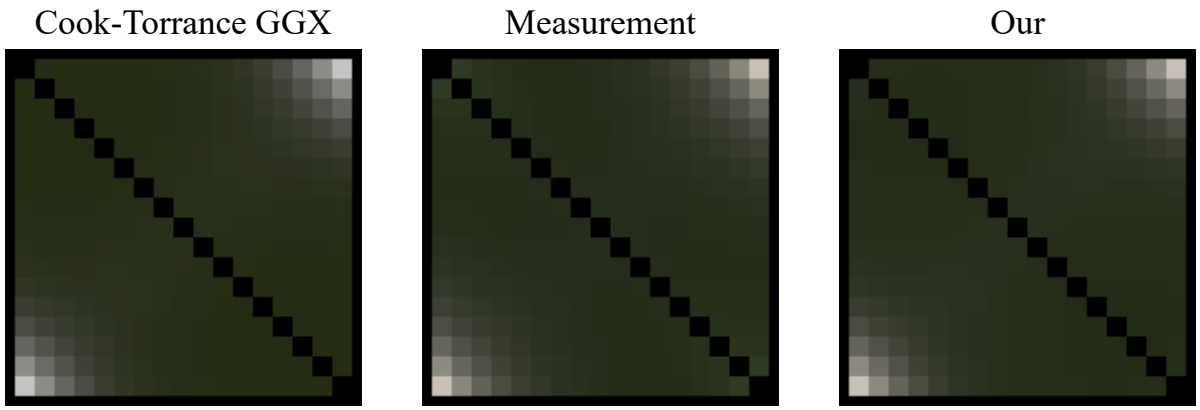


ColorChecker - Patch 4

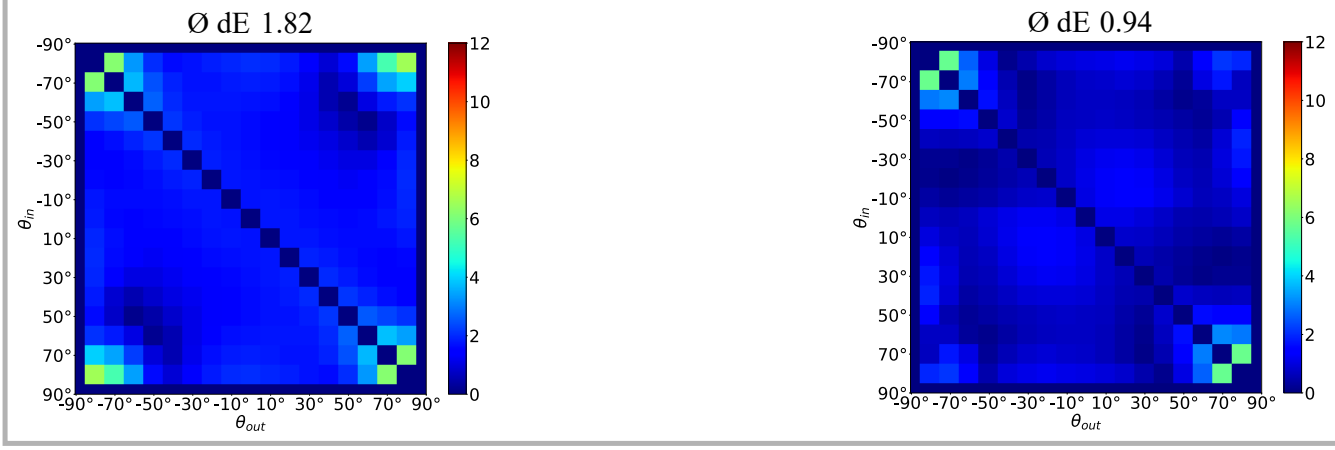
Rendering (Computed with Mitsuba 2)



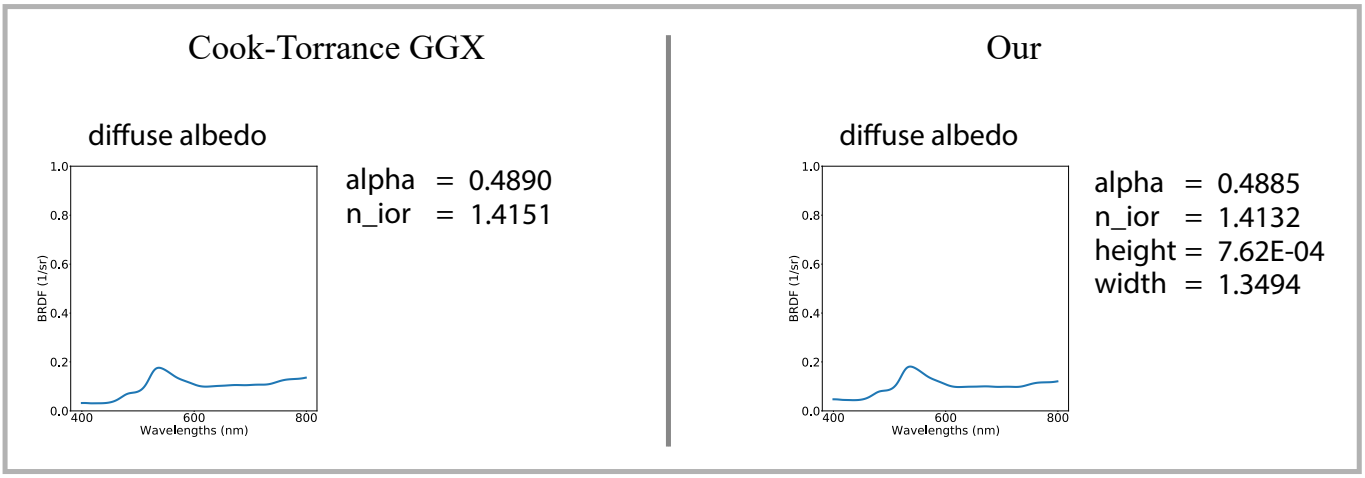
rgb image of in-plane BRDF



dE 2000

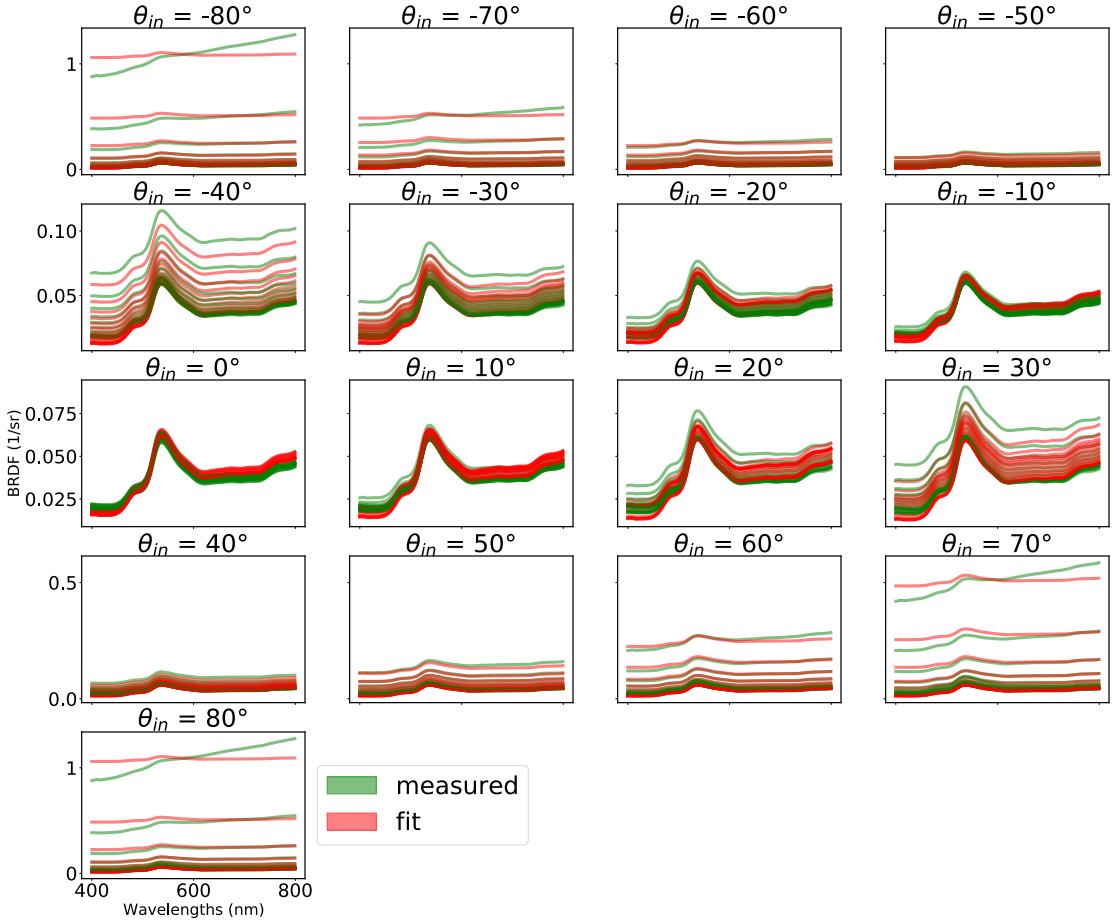


Fitting result

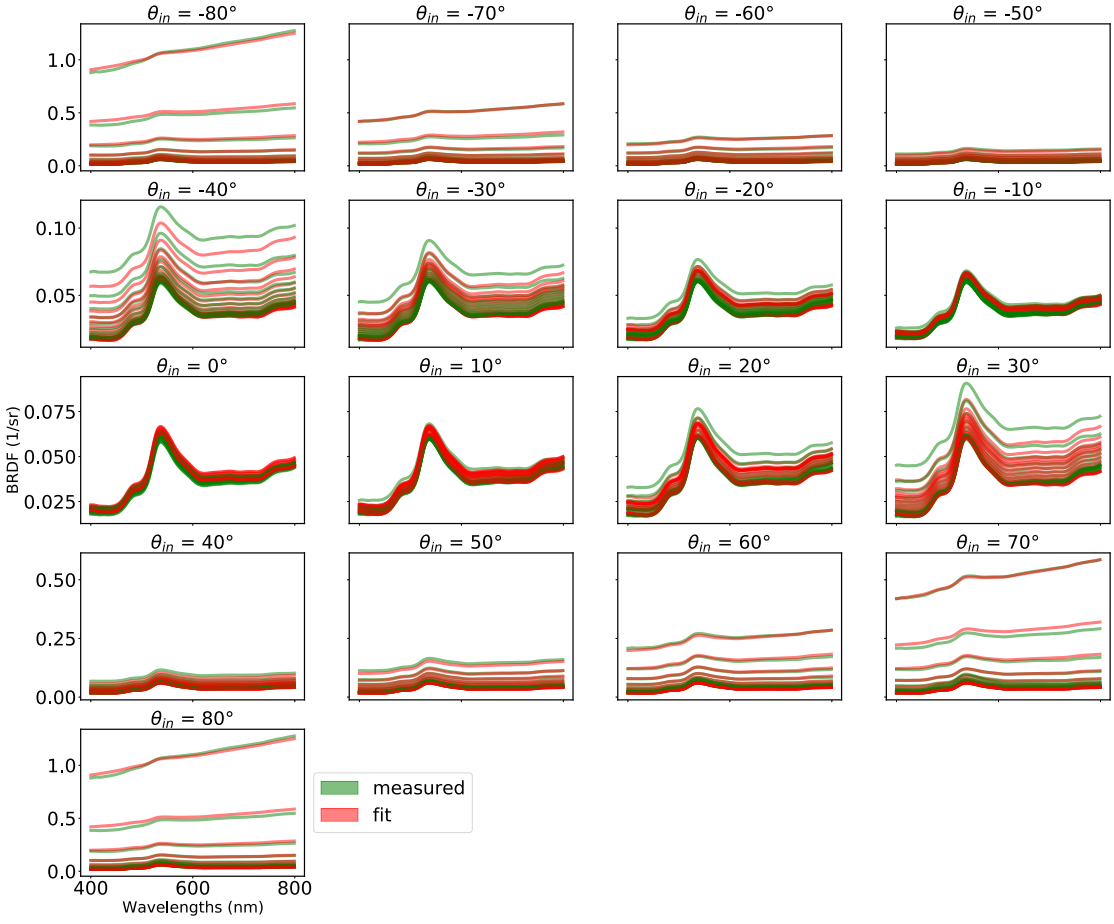


Measured vs. fitted spectra

Cook-Torrance GGX

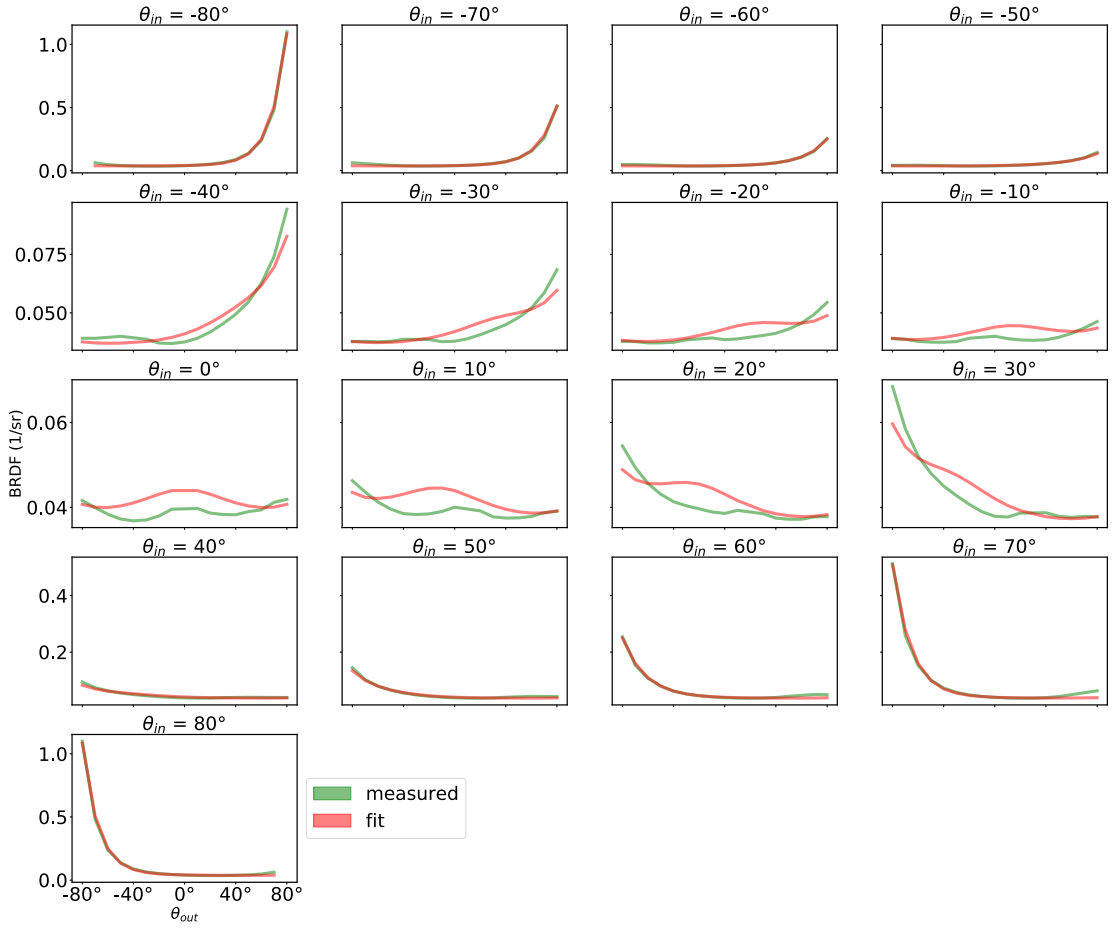


Our

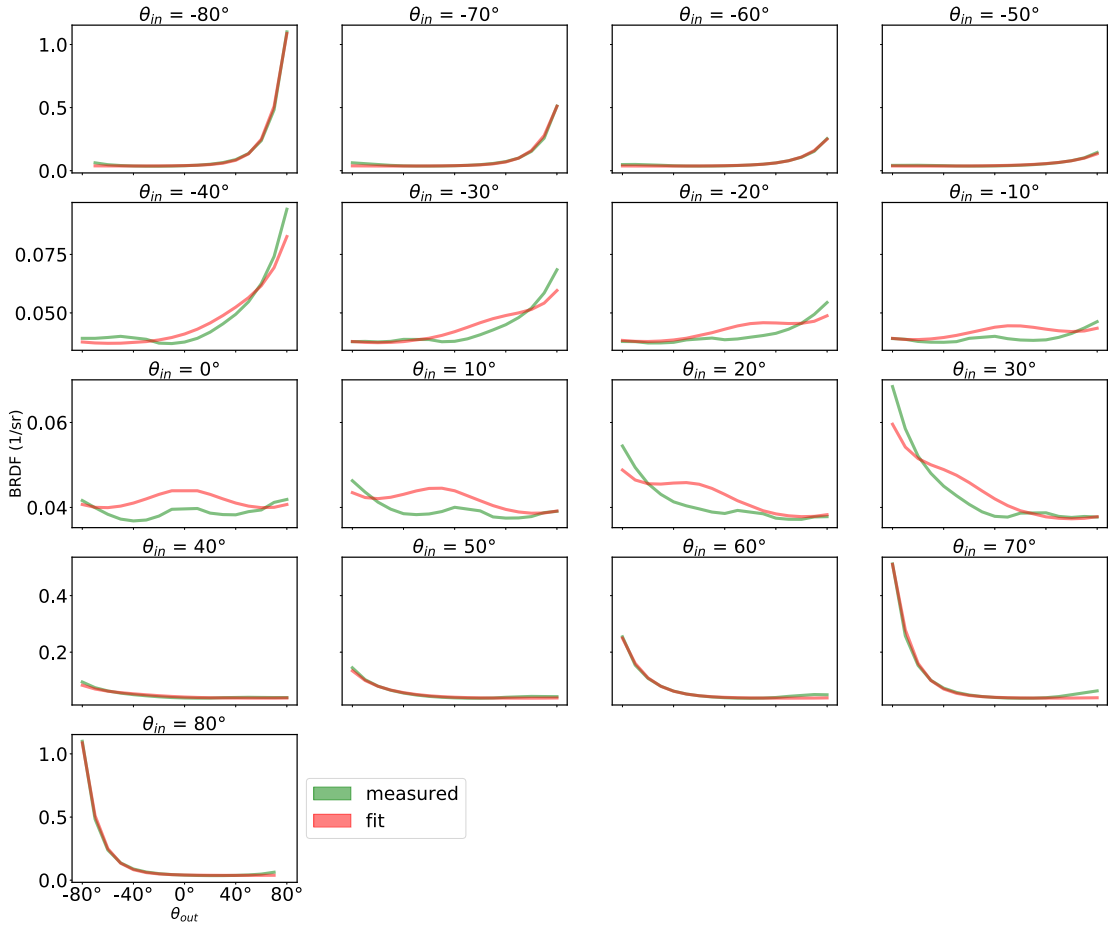


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



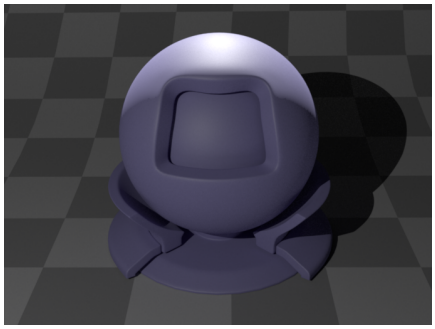
Our



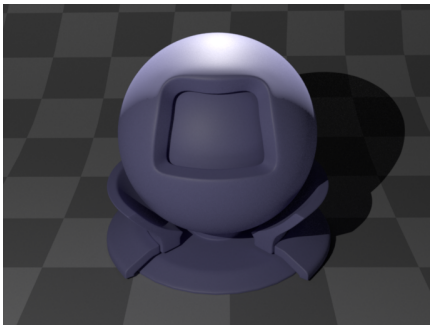
ColorChecker - Patch 5

Rendering (Computed with Mitsuba 2)

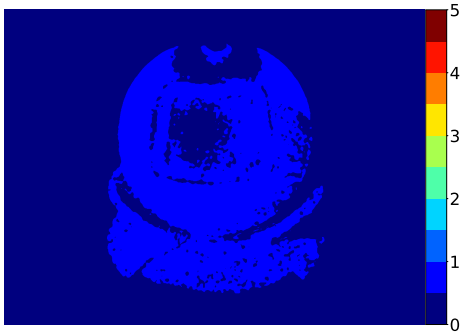
Cook-Torrance GGX



Our

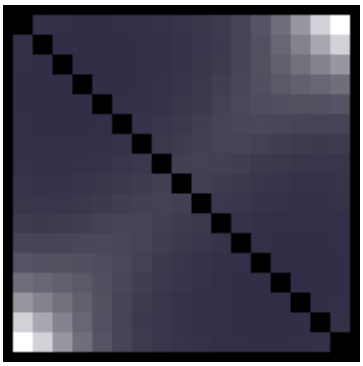


dE 2000

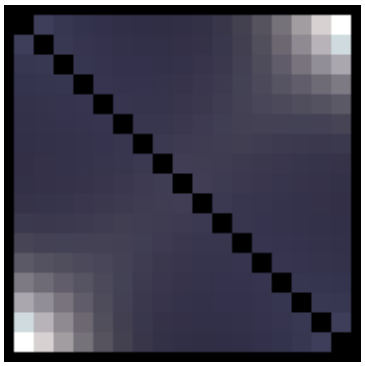


rgb image of in-plane BRDF

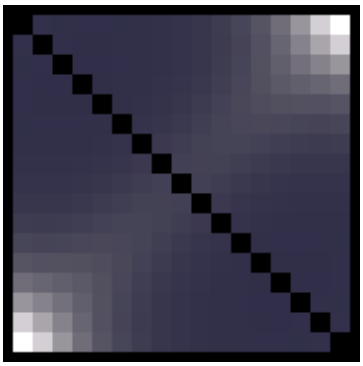
Cook-Torrance GGX



Measurement

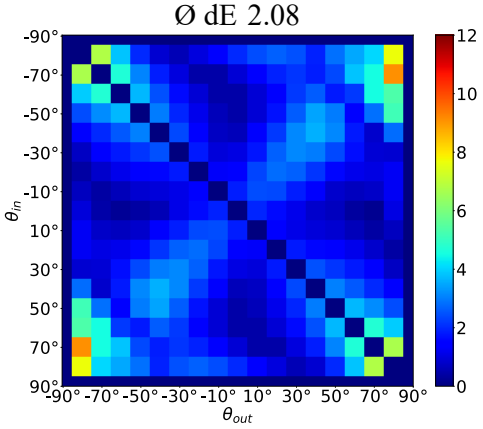


Our

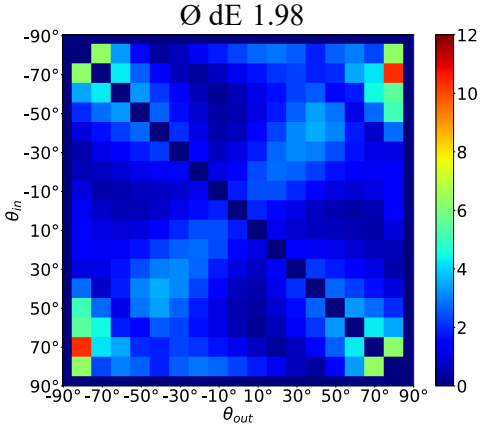


dE 2000

Ø dE 2.08



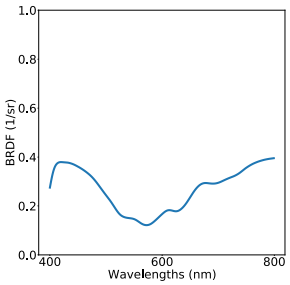
Ø dE 1.98



Fitting result

Cook-Torrance GGX

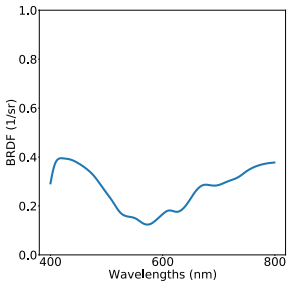
diffuse albedo



alpha = 0.3834
n_ior = 1.9754

Our

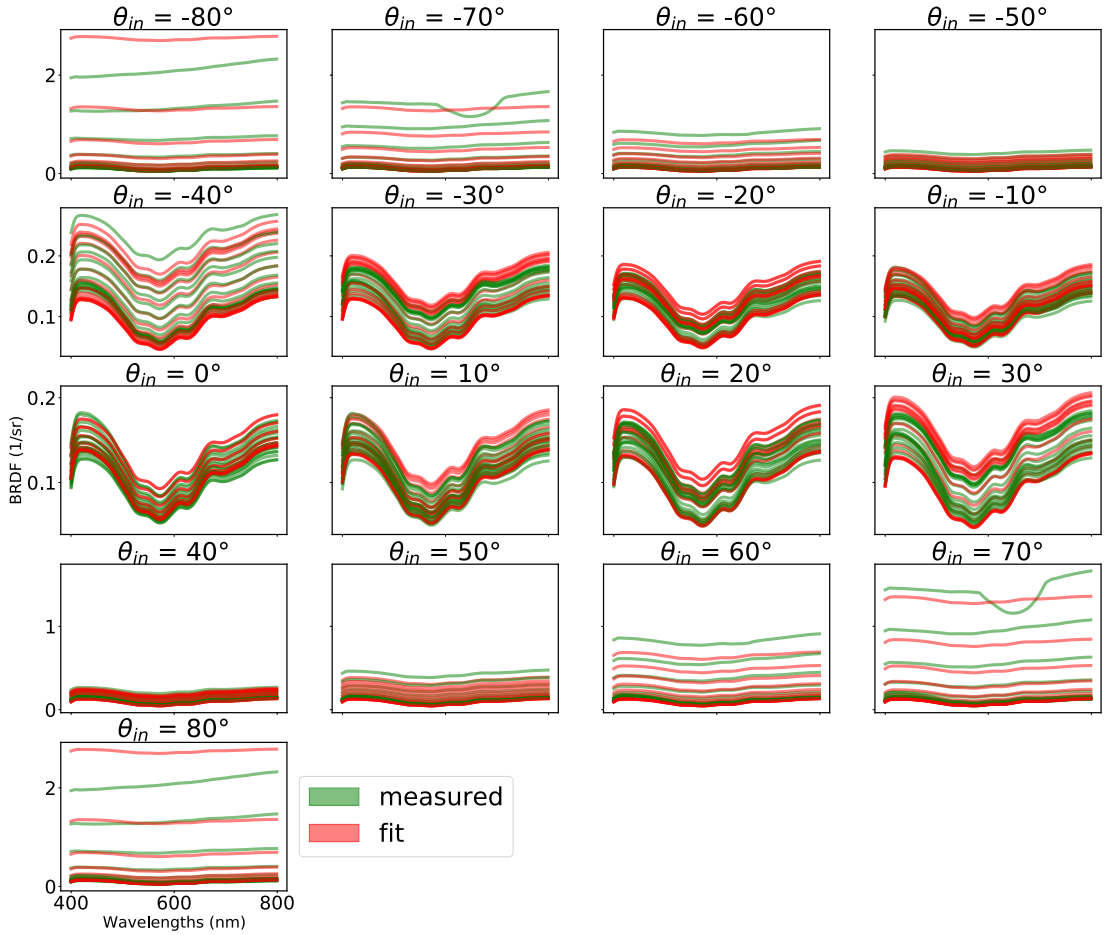
diffuse albedo



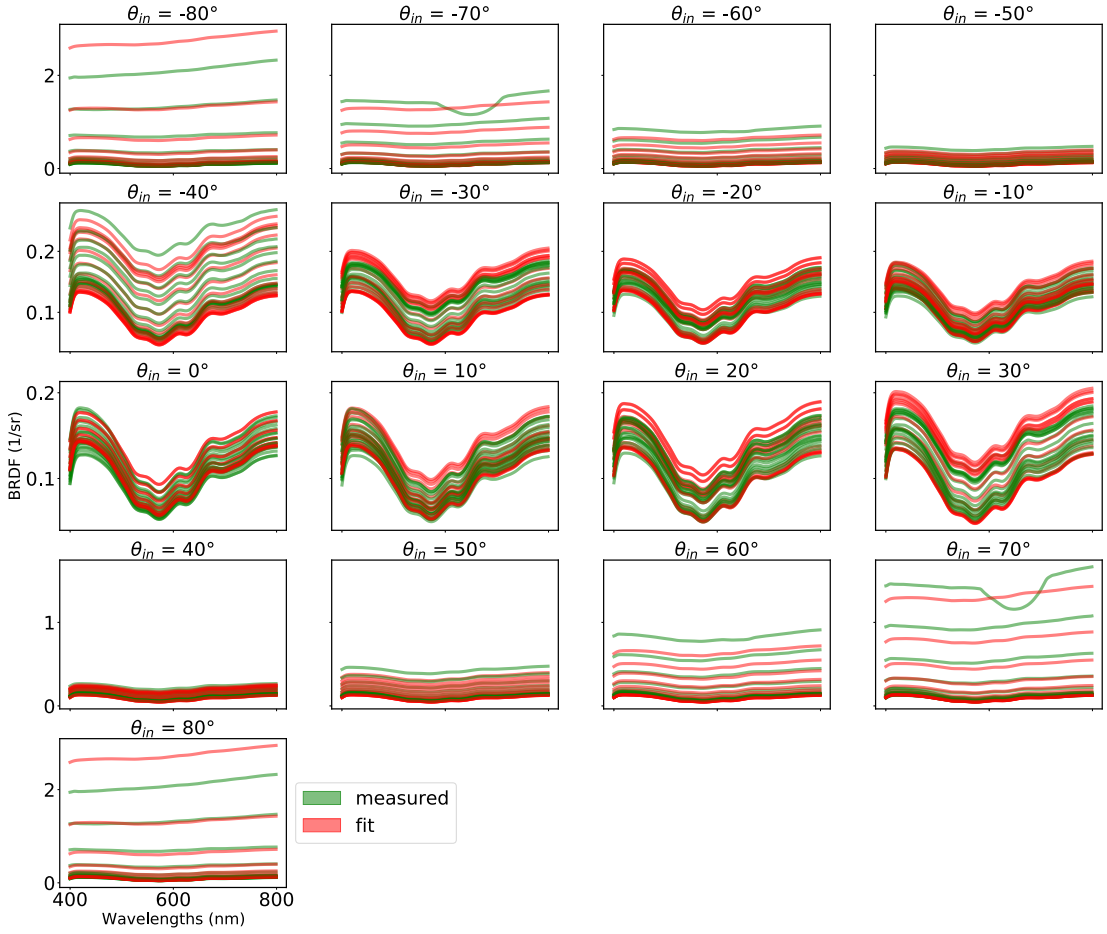
alpha = 0.3834
n_ior = 1.9756
height = 3.15E-04
width = 2.2454

Measured vs. fitted spectra

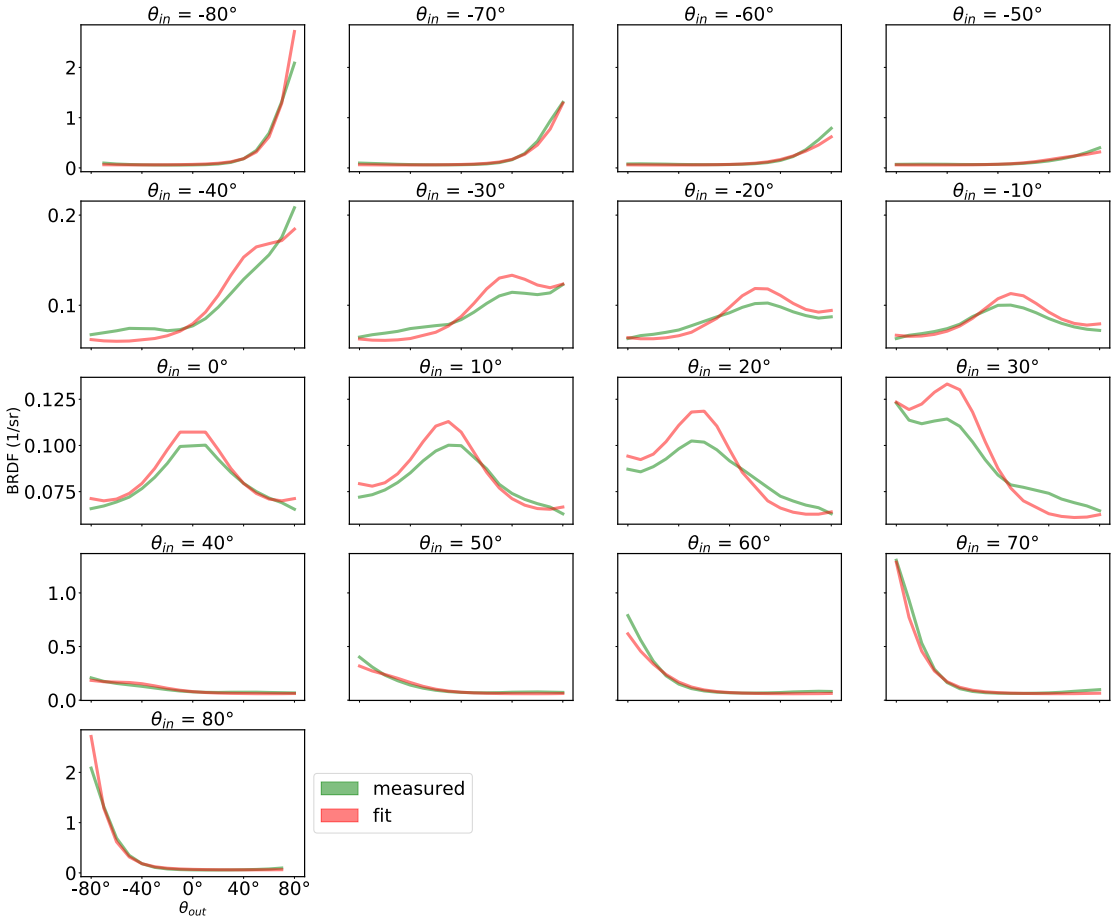
Cook-Torrance GGX

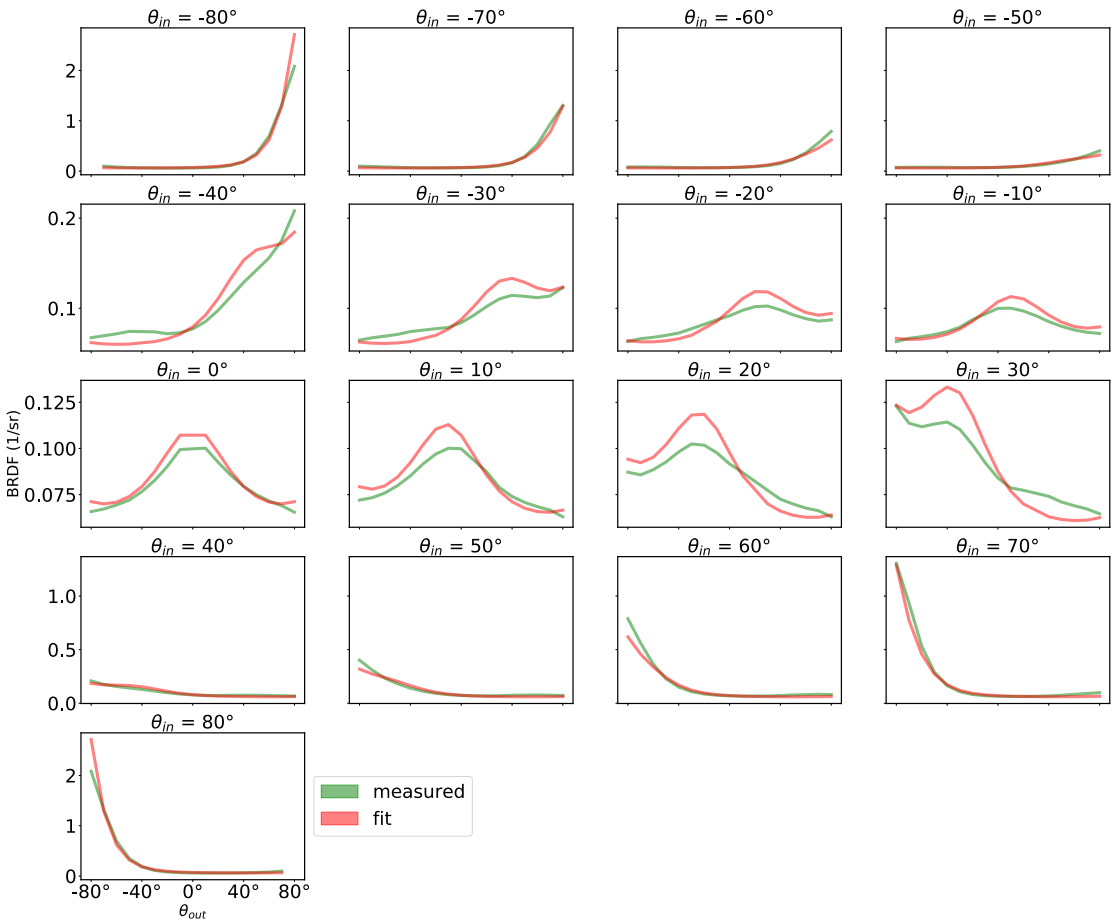


Our



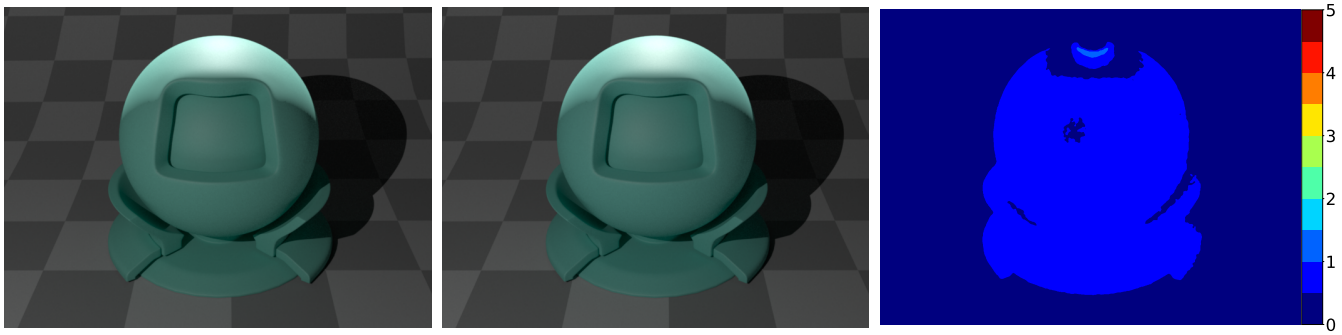
Measured vs. fitted
scatter distribution at 600 nm



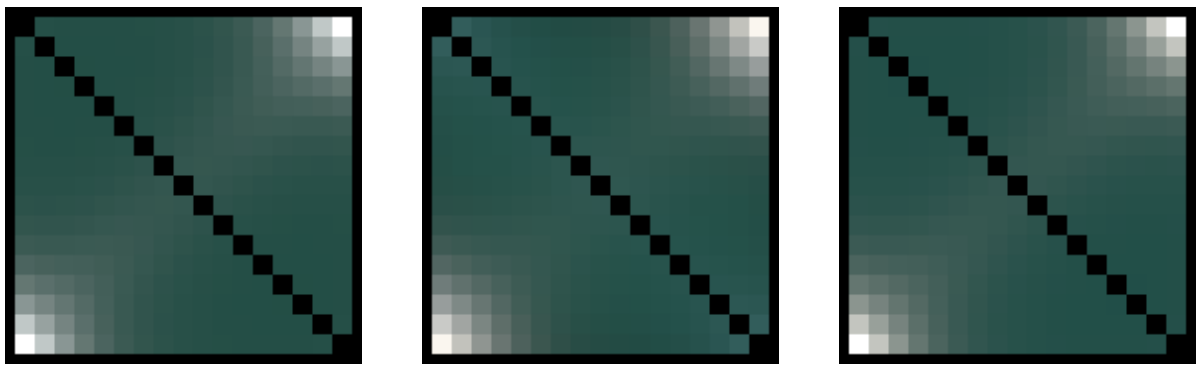


ColorChecker - Patch 6

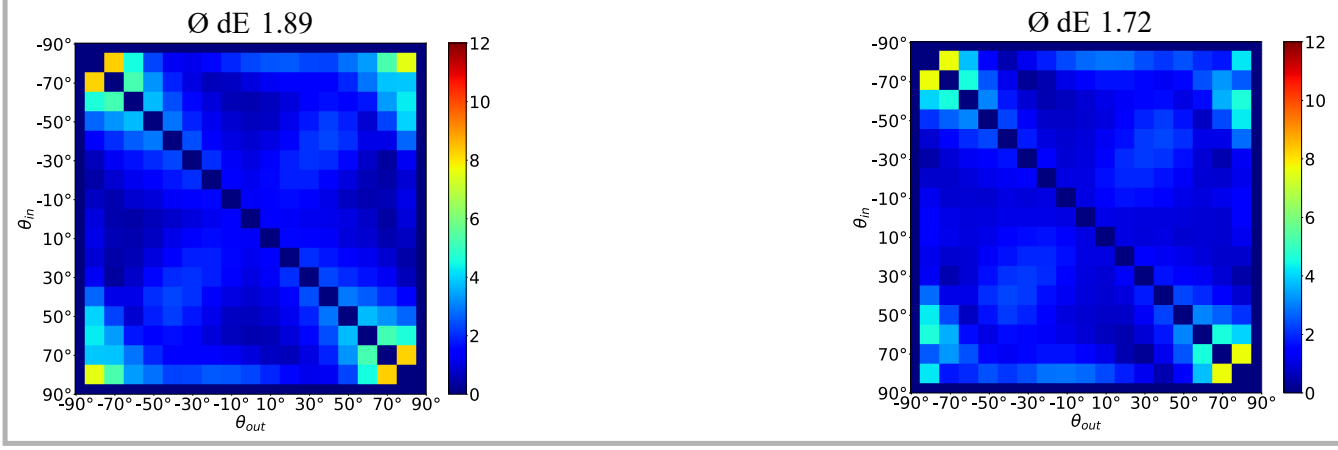
Rendering
(Computed with Mitsuba 2)



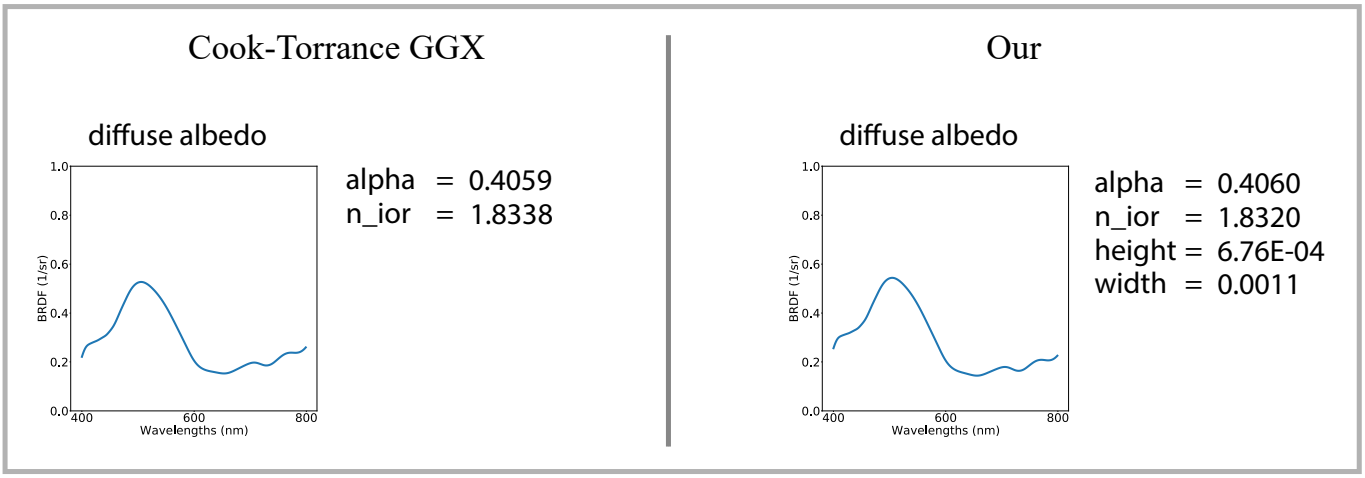
rgb image of
in-plane BRDF



dE 2000

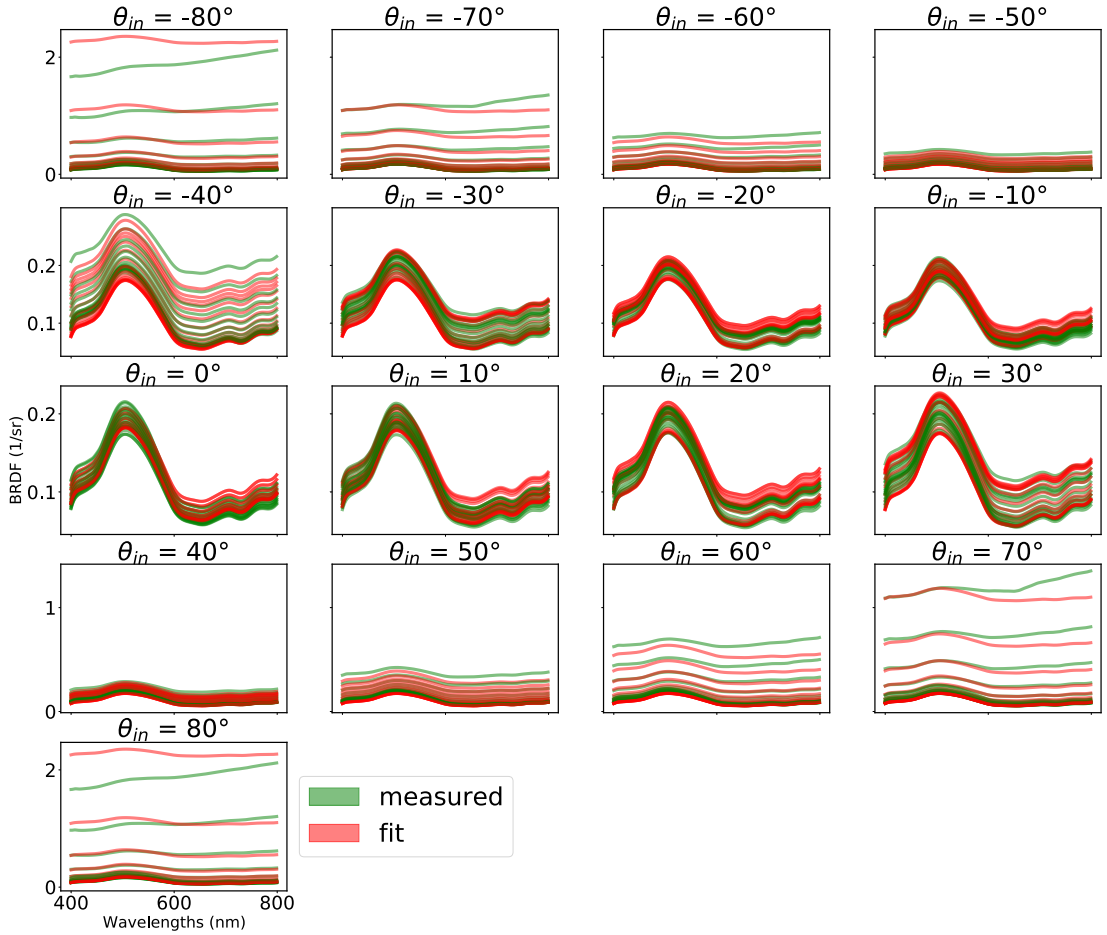


Fitting result

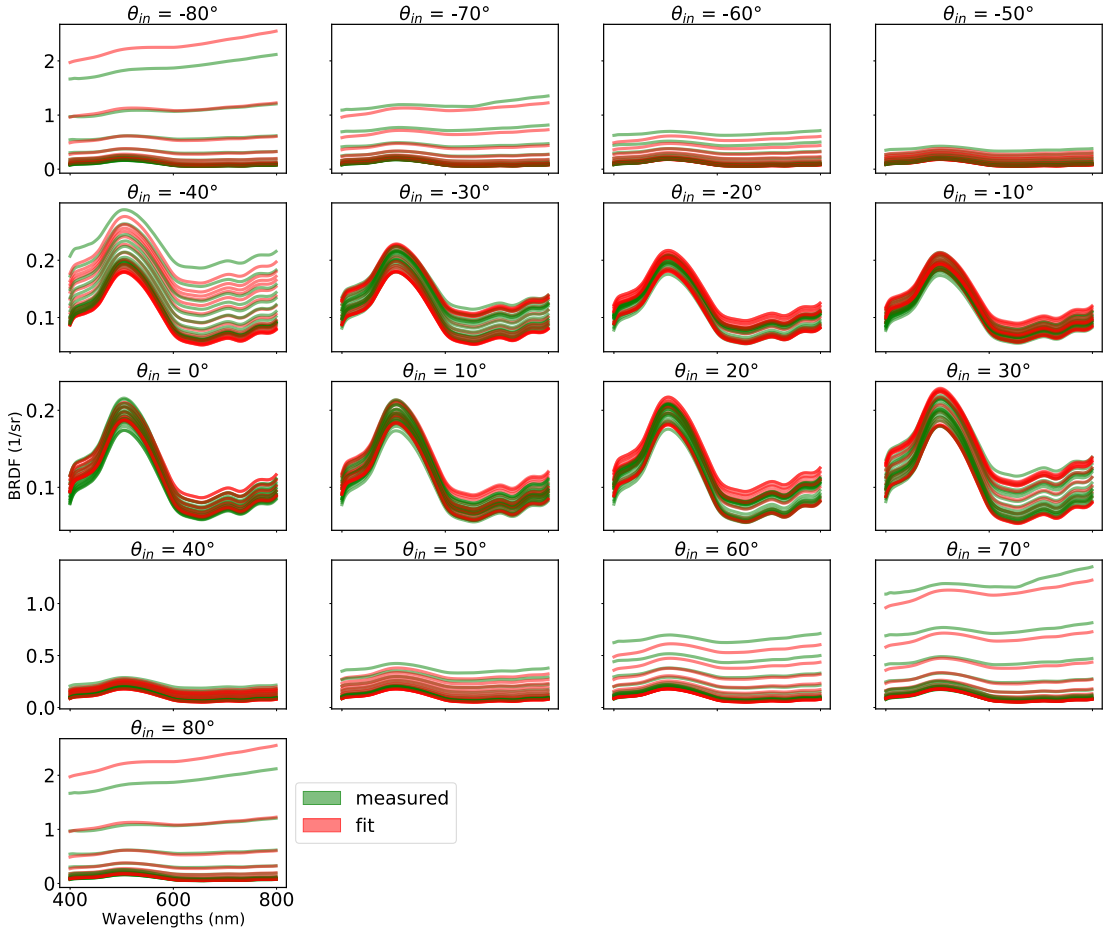


Measured vs. fitted spectra

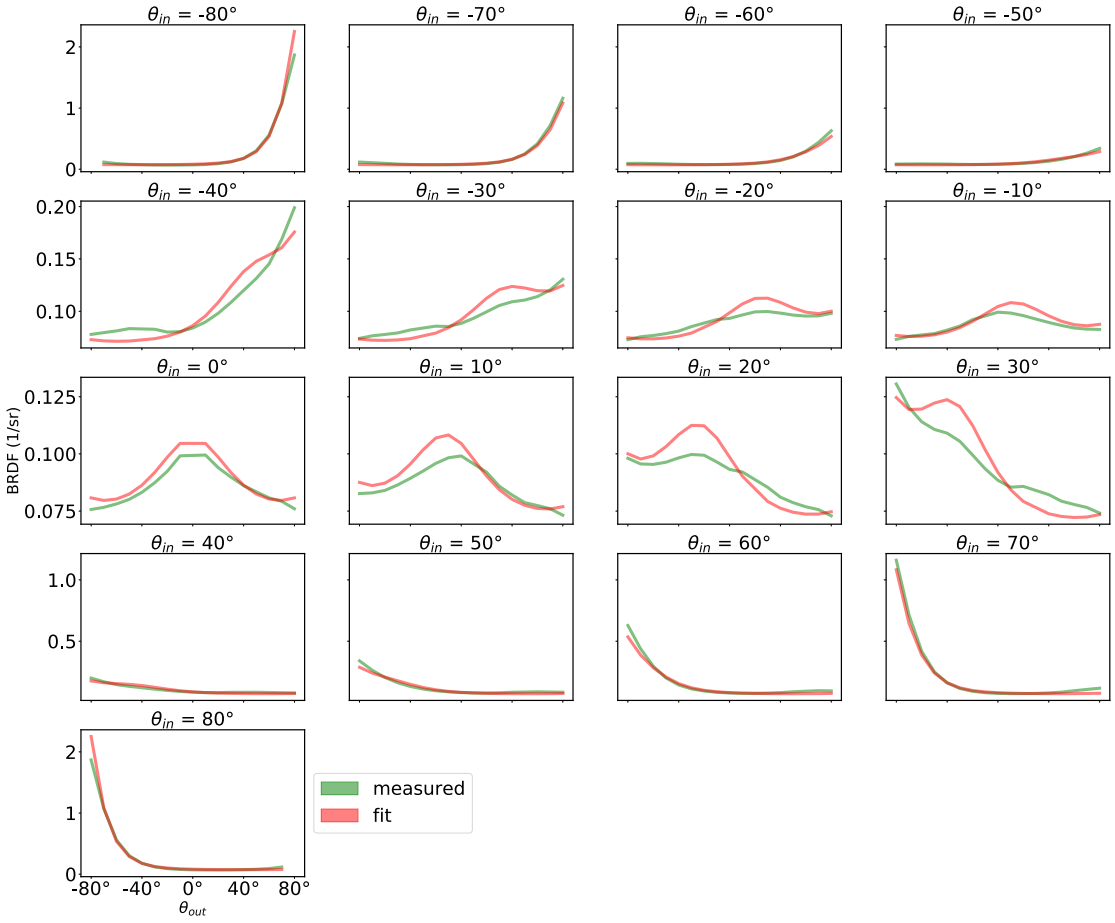
Cook-Torrance GGX

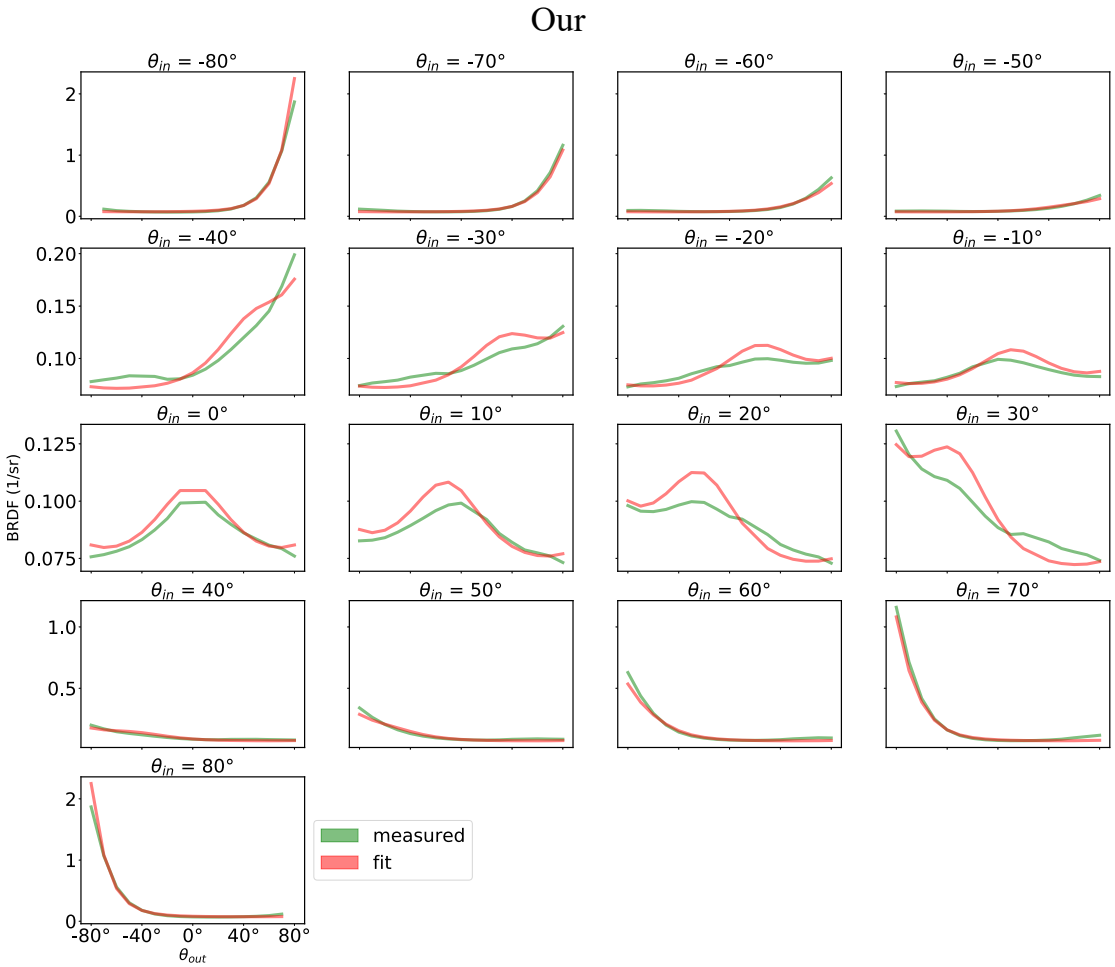


Our



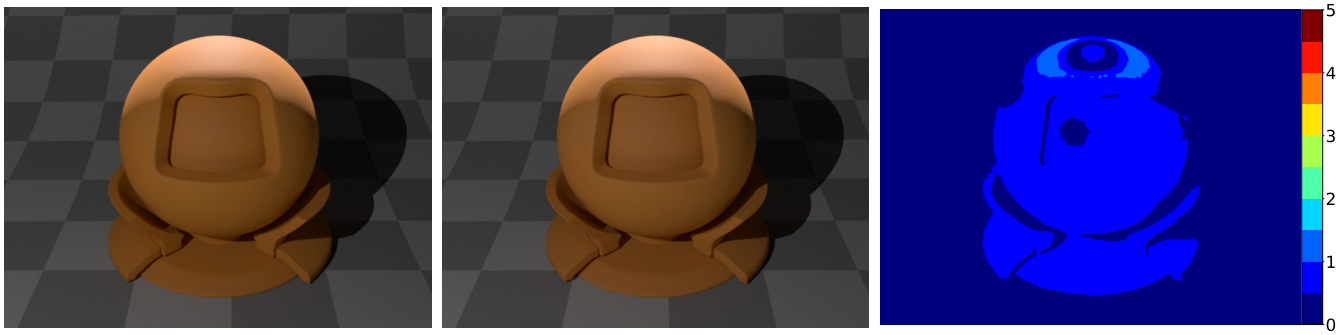
Measured vs. fitted
scatter distribution at 600 nm



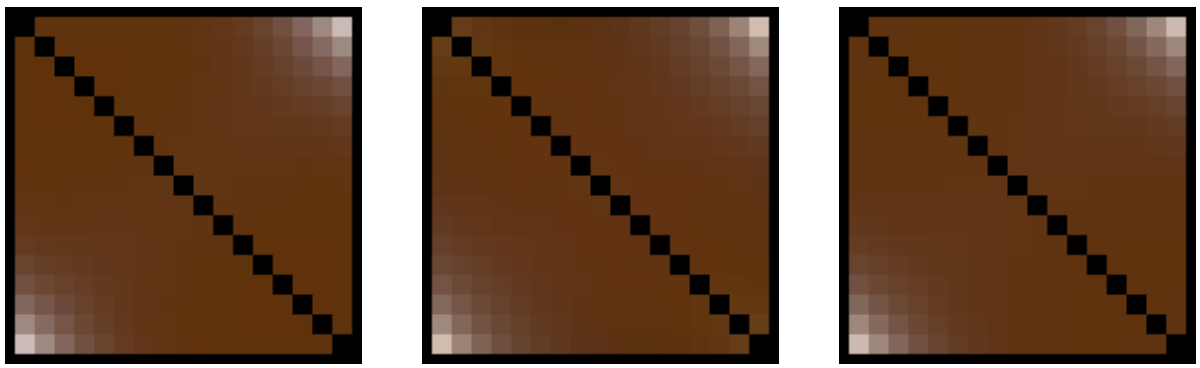


ColorChecker - Patch 7

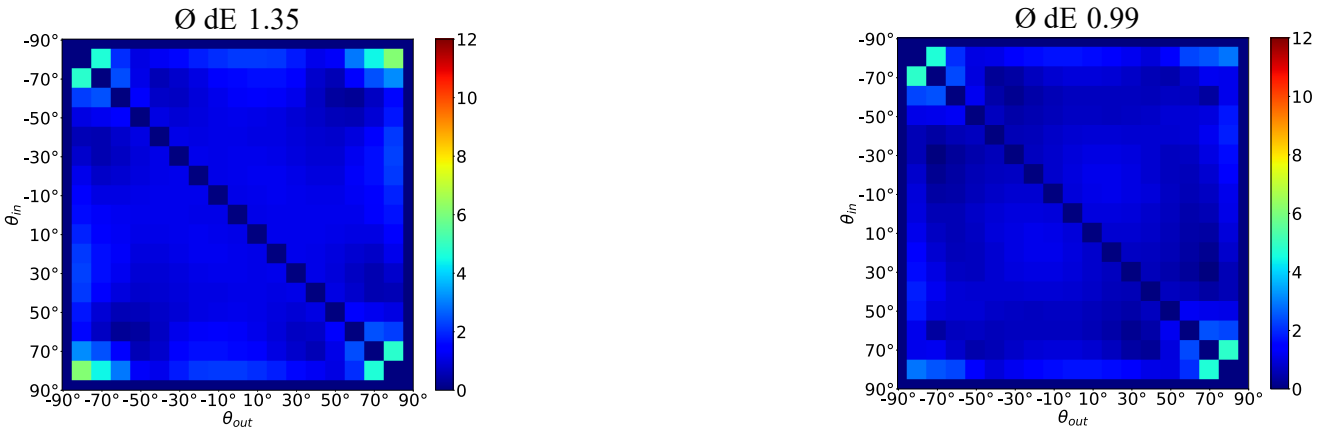
Rendering (Computed with Mitsuba 2)



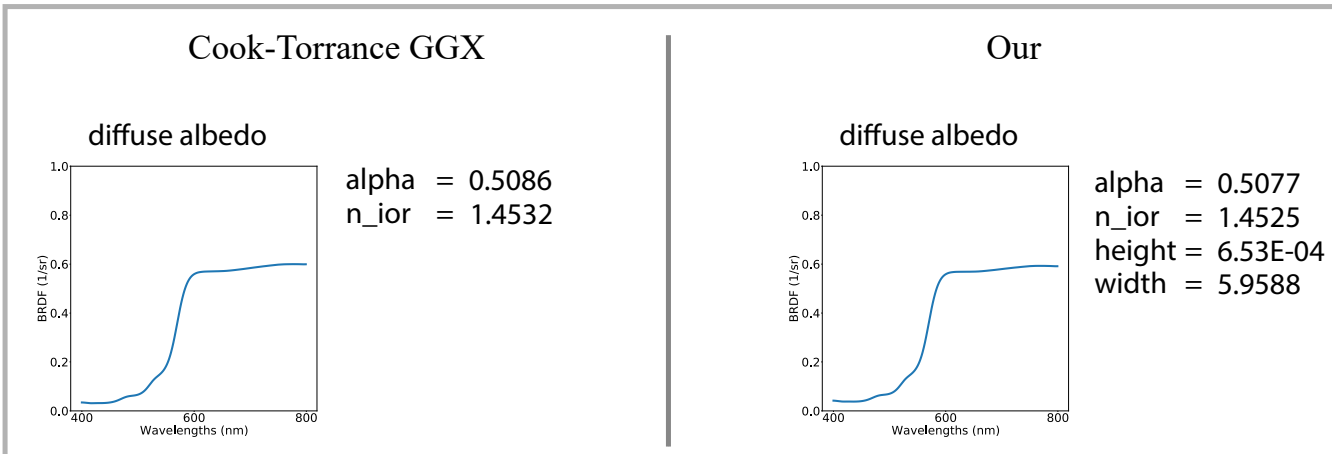
rgb image of in-plane BRDF



dE 2000

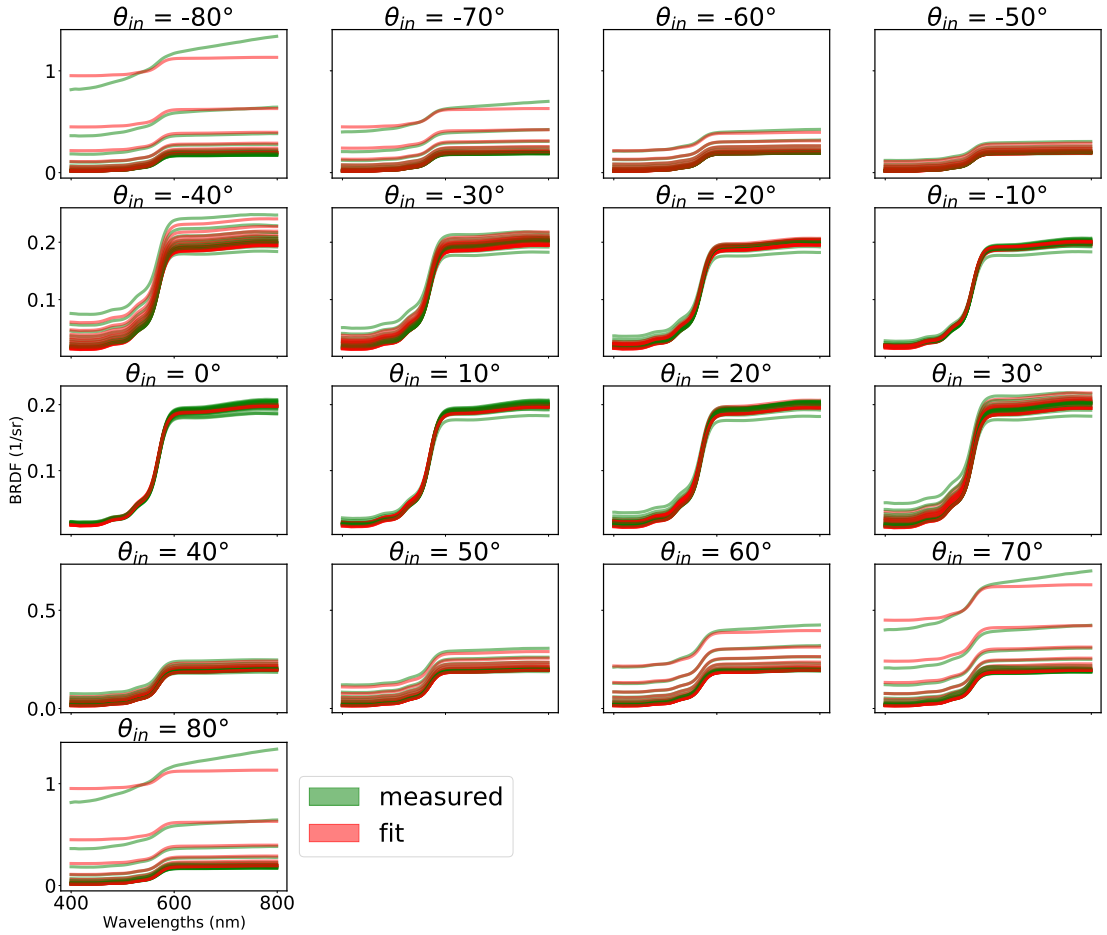


Fitting result

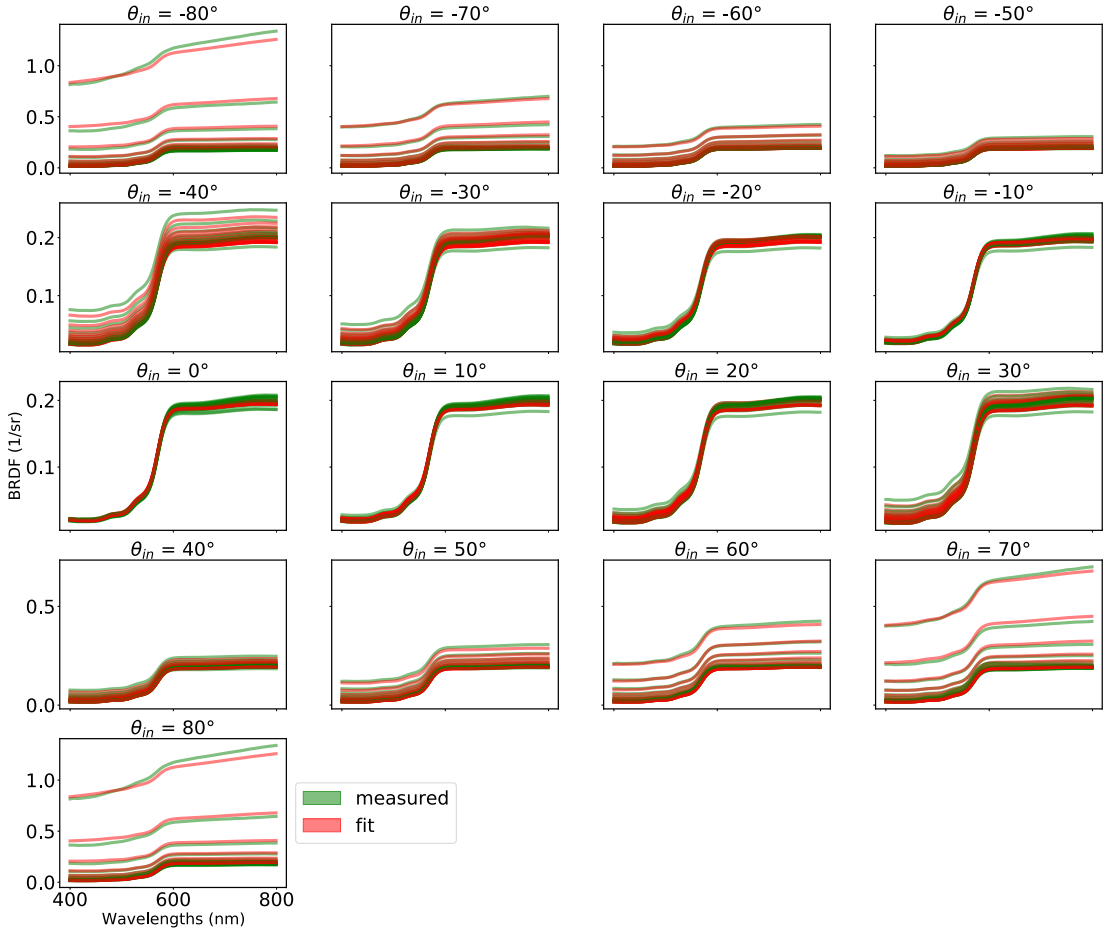


Measured vs. fitted spectra

Cook-Torrance GGX

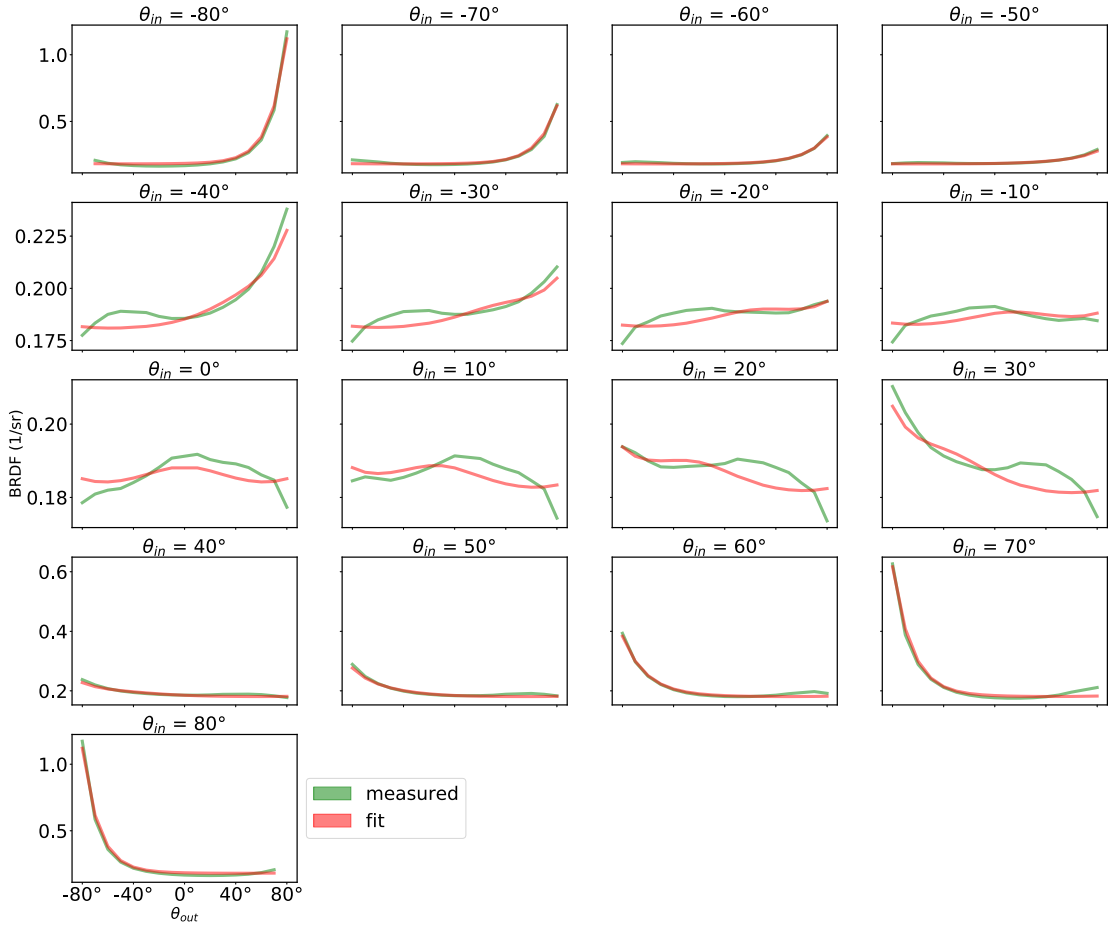


Our

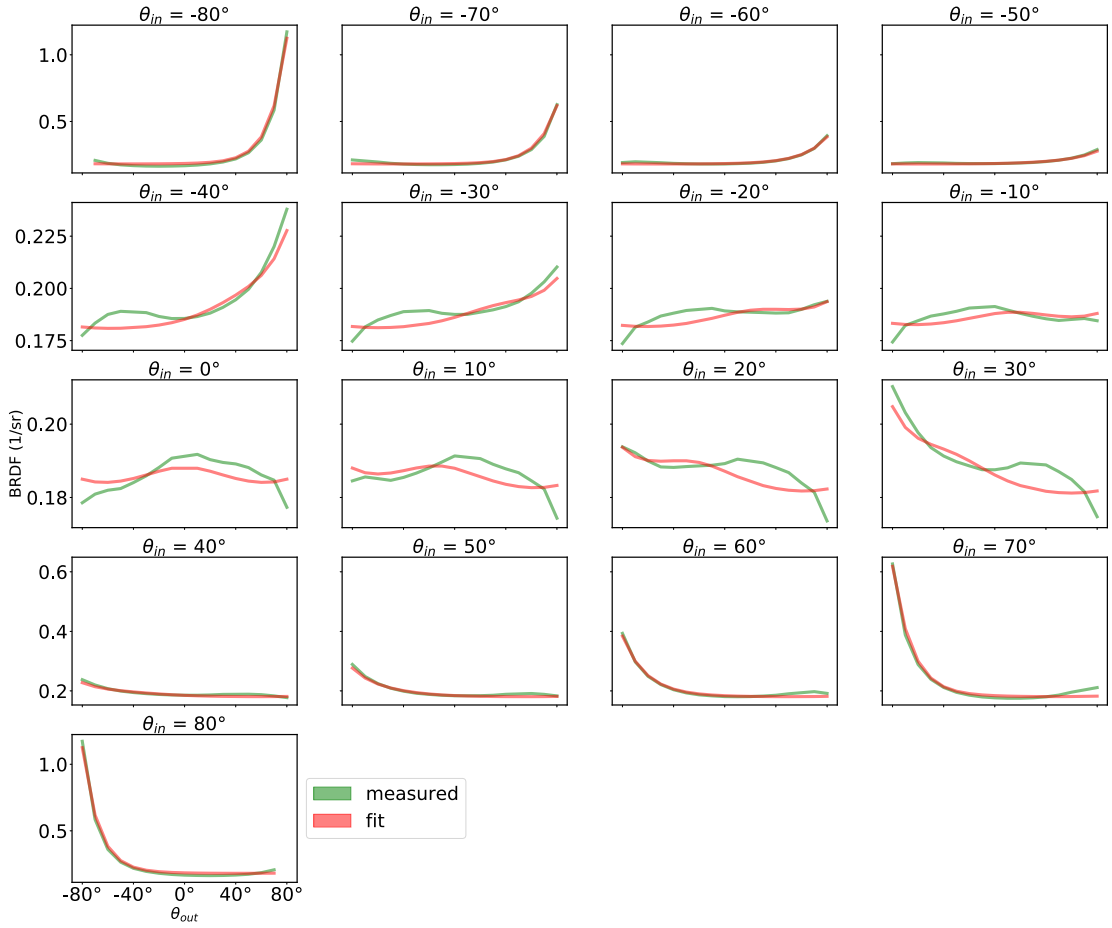


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



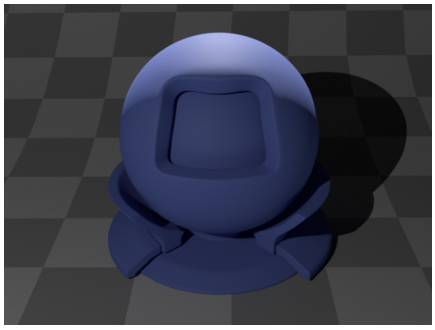
Our



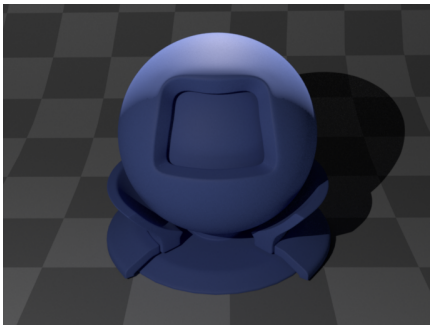
ColorChecker - Patch 8

Rendering (Computed with Mitsuba 2)

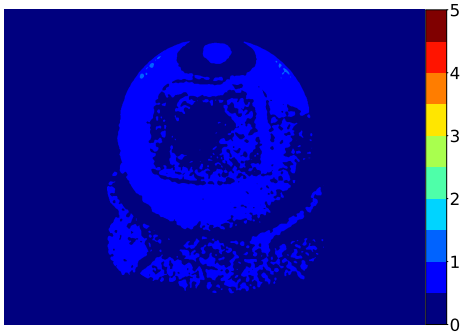
Cook-Torrance GGX



Our

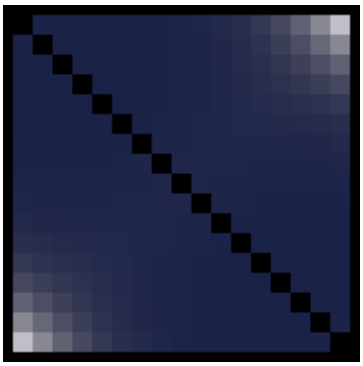


dE 2000

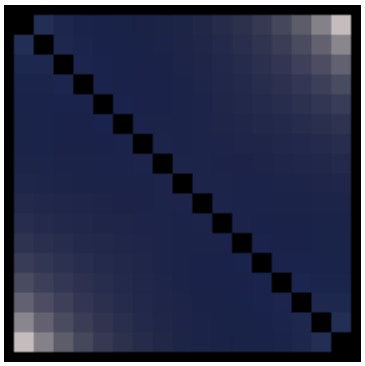


rgb image of in-plane BRDF

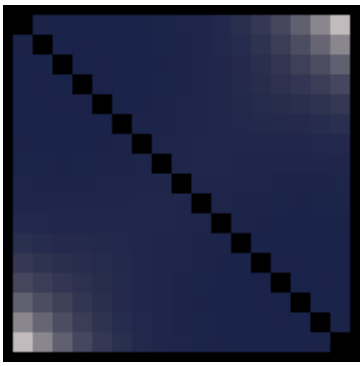
Cook-Torrance GGX



Measurement

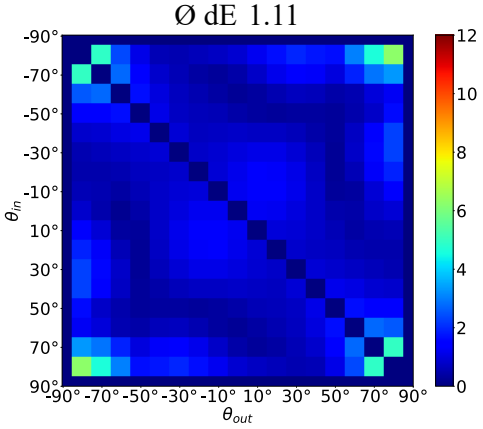


Our

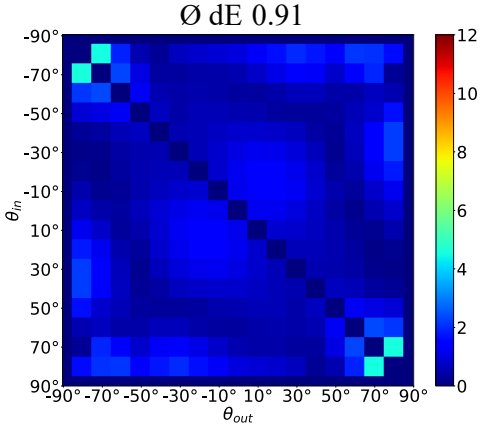


dE 2000

Ø dE 1.11



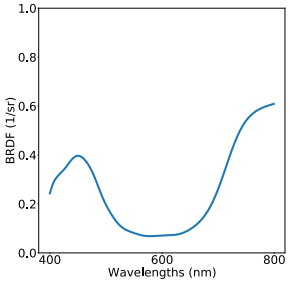
Ø dE 0.91



Fitting result

Cook-Torrance GGX

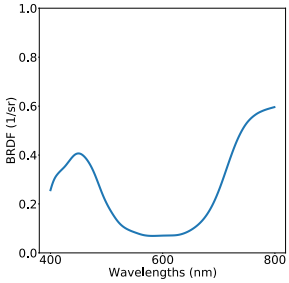
diffuse albedo



alpha = 0.4962
n_ior = 1.4395

Our

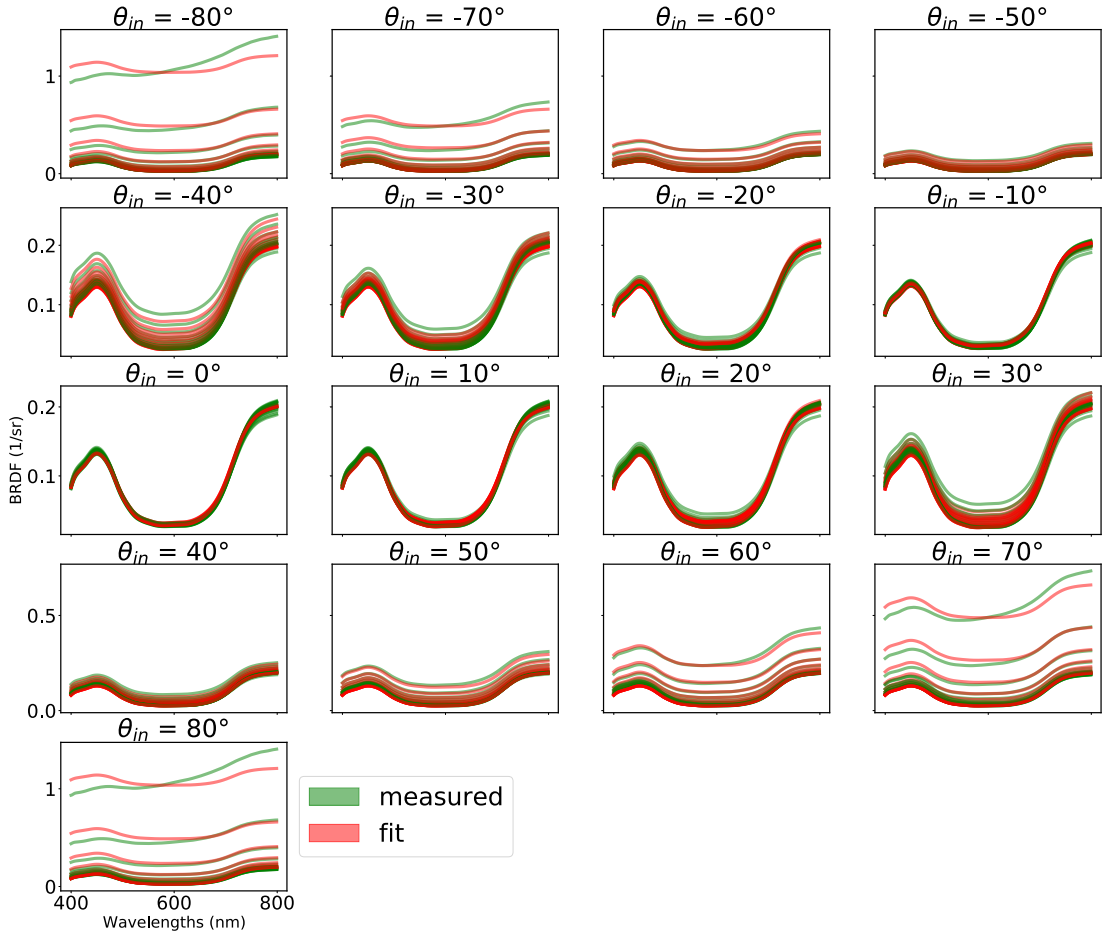
diffuse albedo



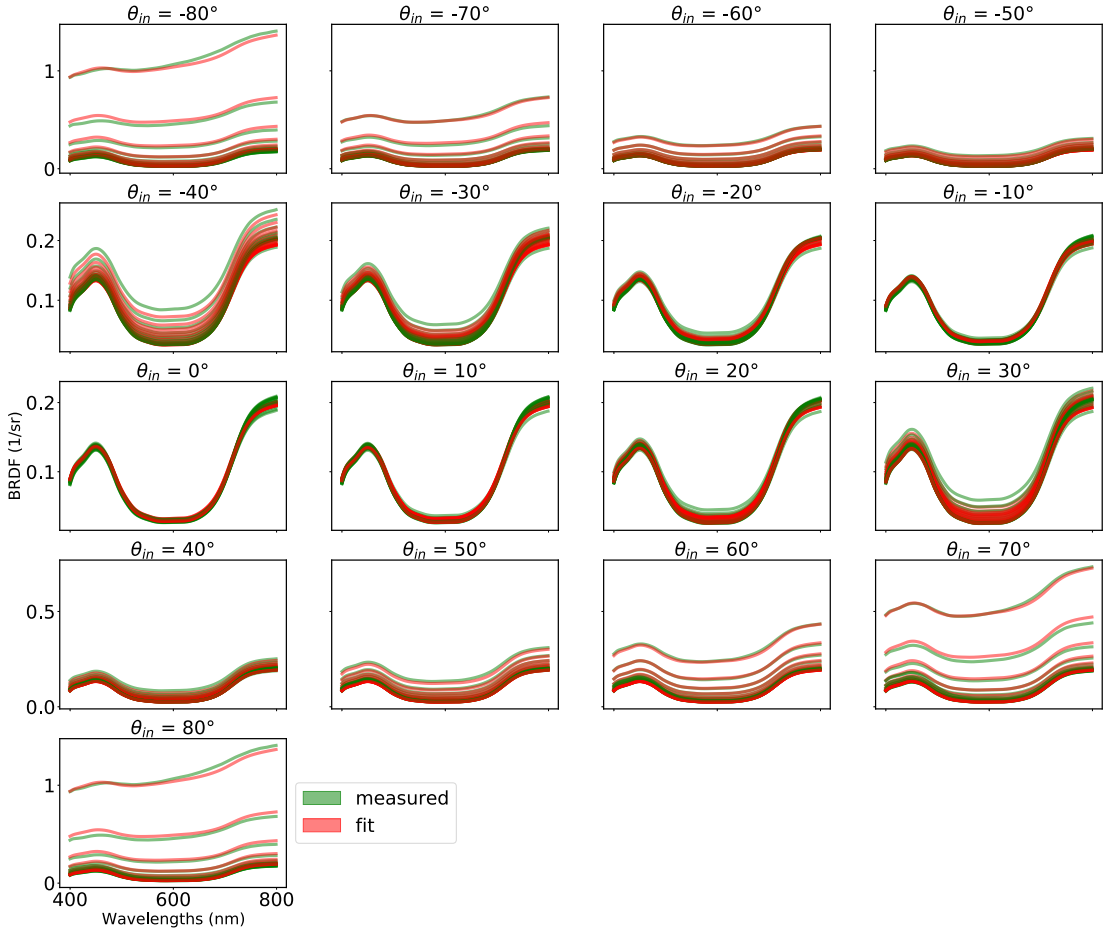
alpha = 0.4961
n_ior = 1.4406
height = 7.85E-04
width = 3.2662

Measured vs. fitted spectra

Cook-Torrance GGX

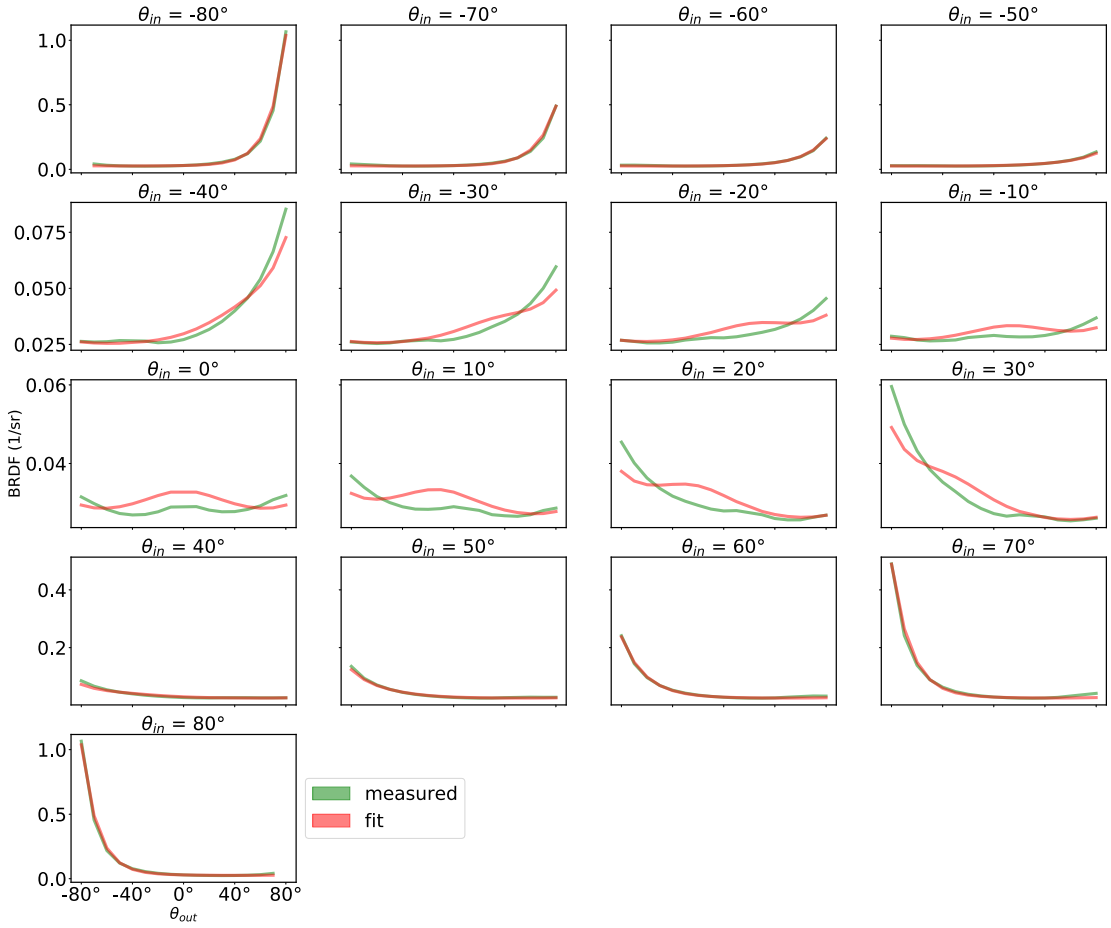


Our

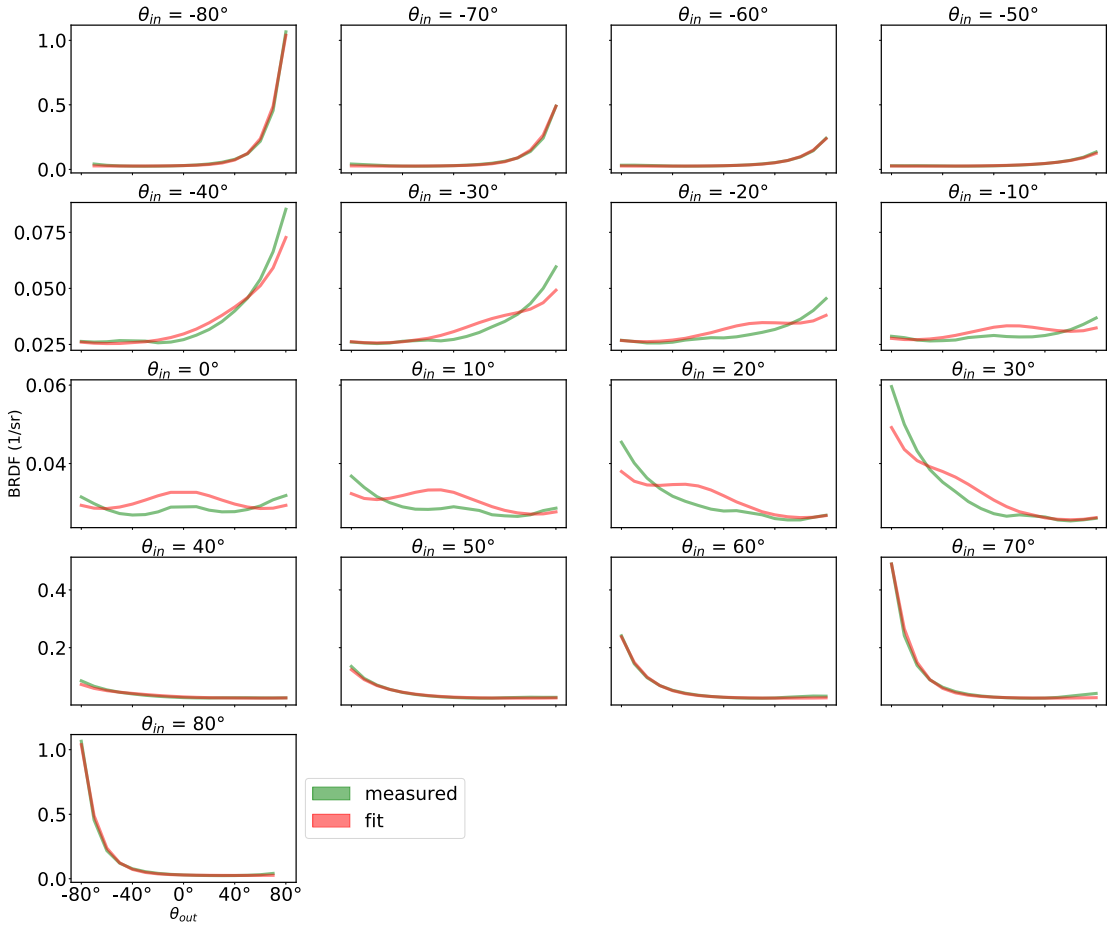


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

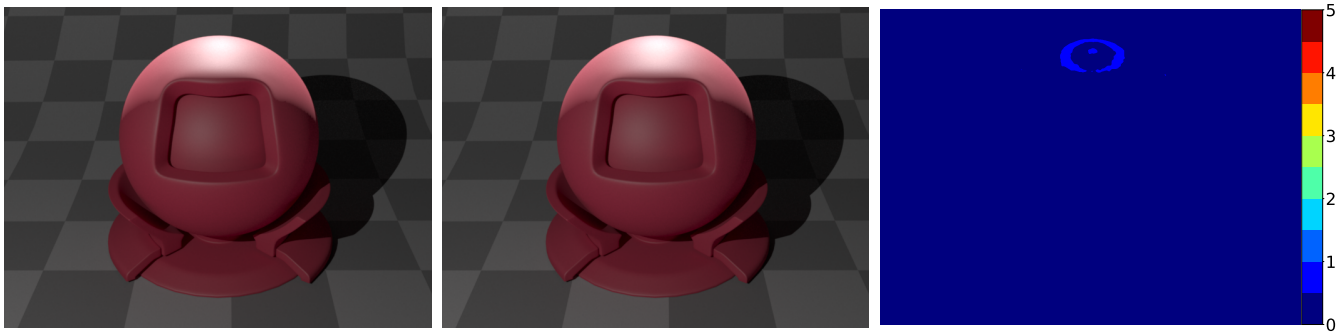


Our

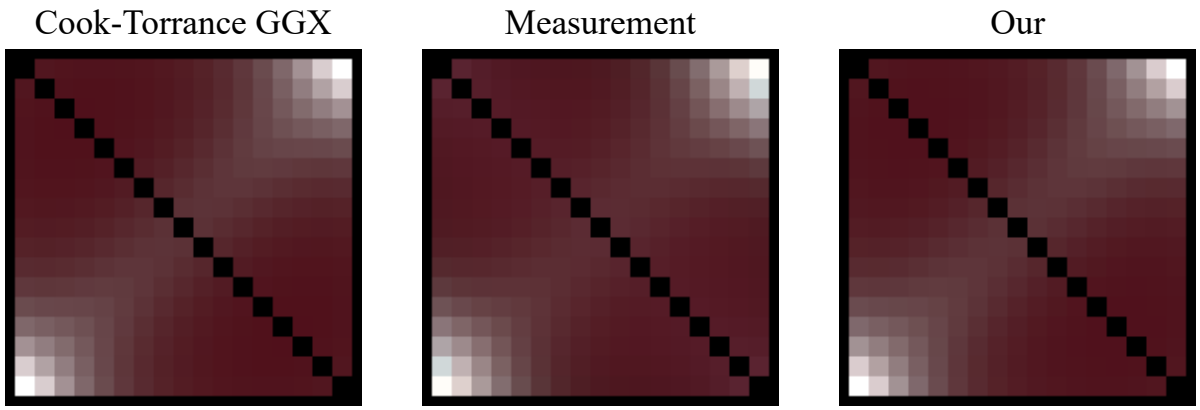


ColorChecker - Patch 9

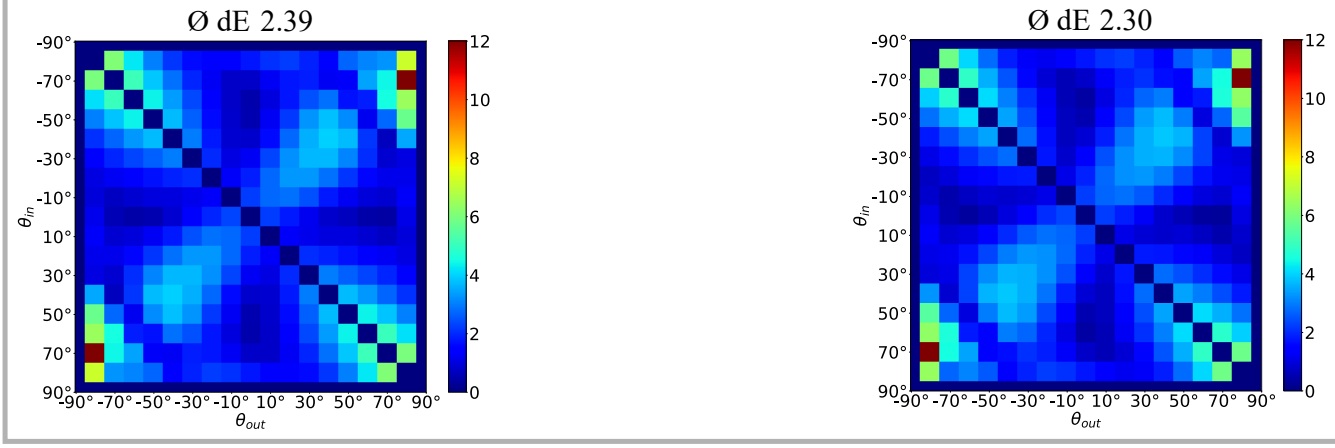
Rendering
(Computed with Mitsuba 2)



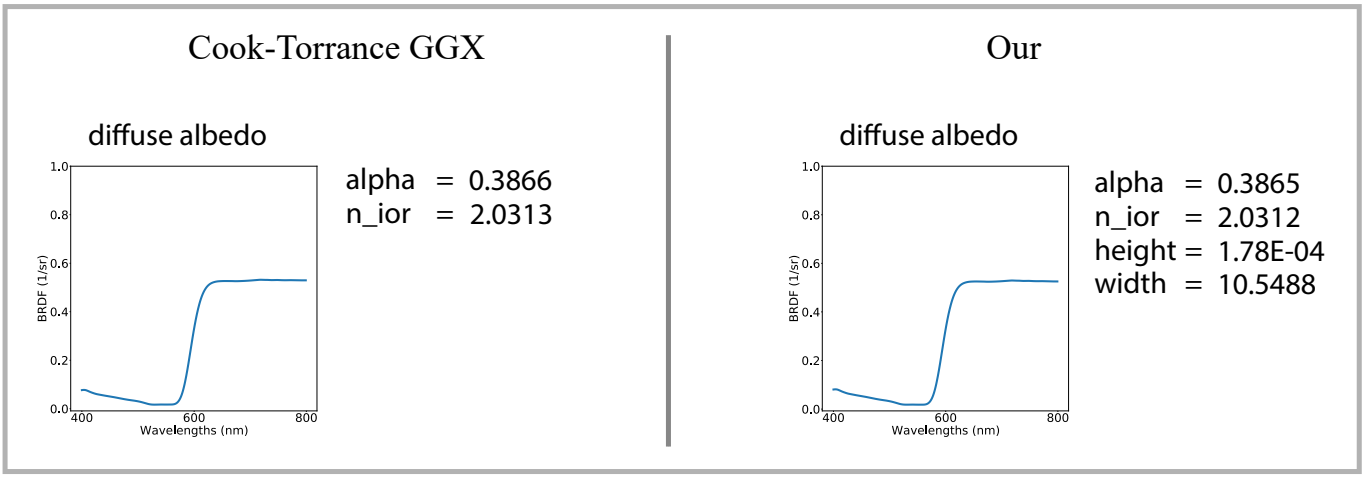
rgb image of
in-plane BRDF



dE 2000

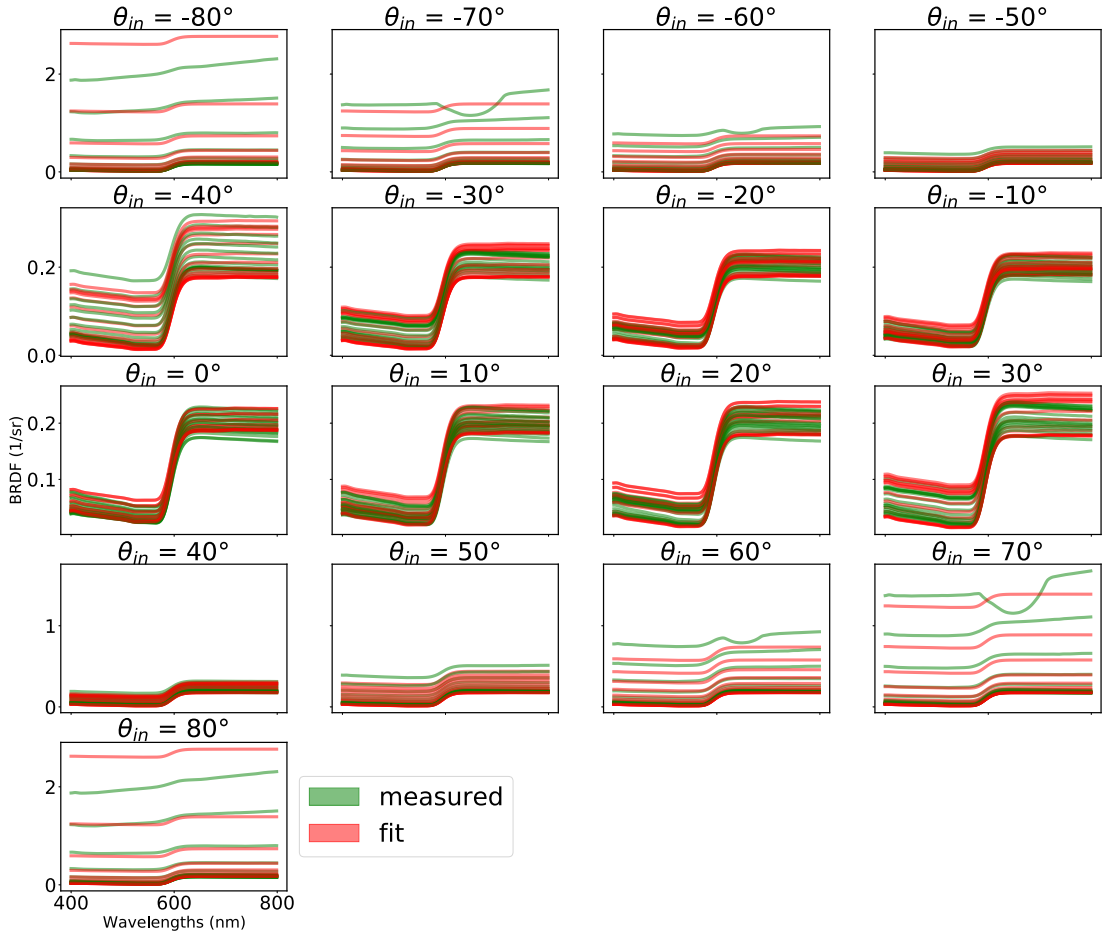


Fitting result

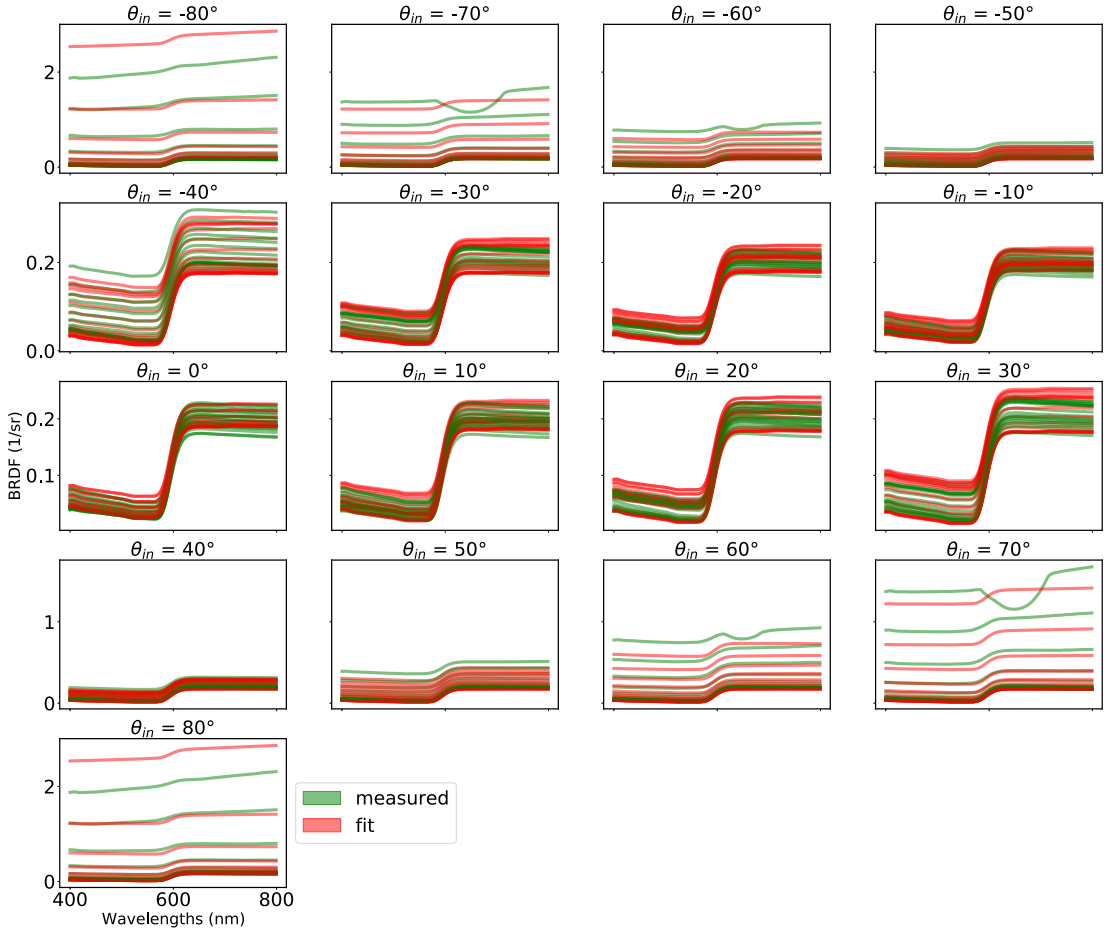


Measured vs. fitted spectra

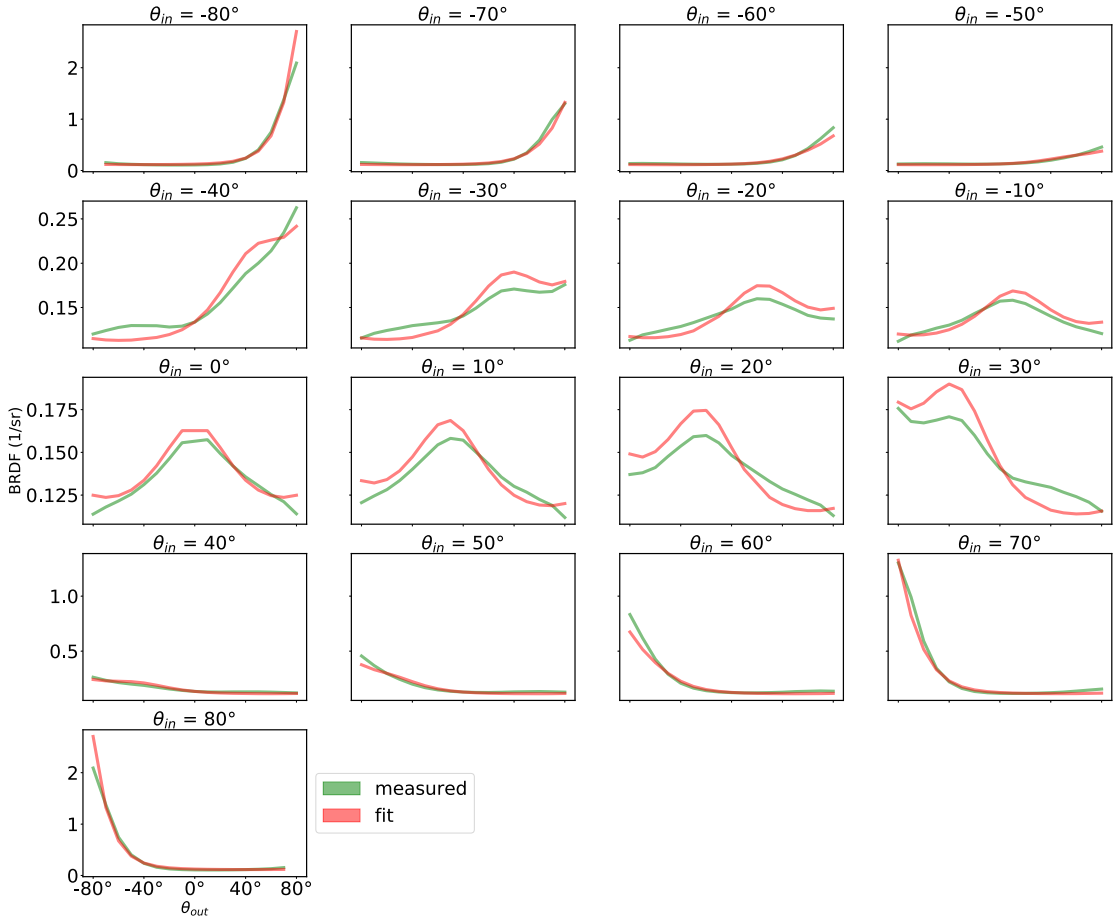
Cook-Torrance GGX

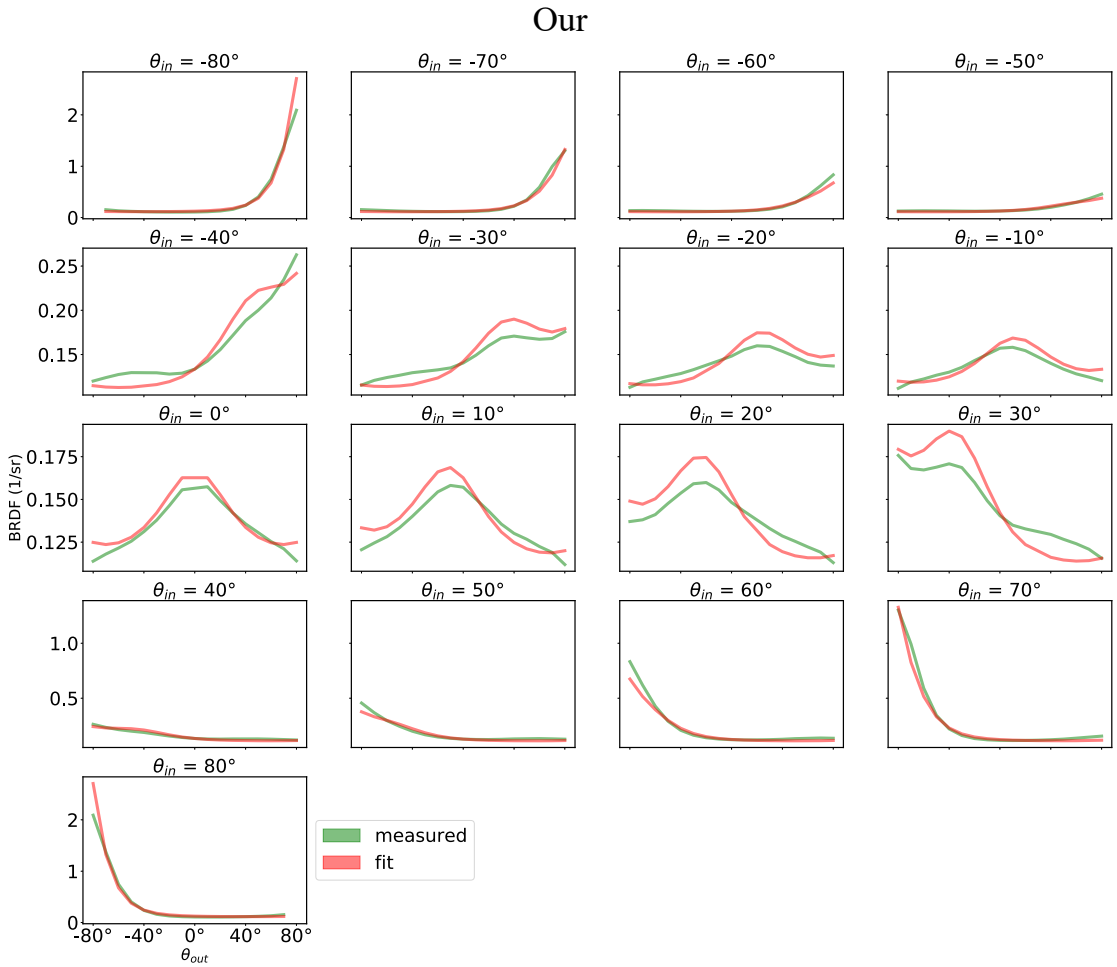


Our



Measured vs. fitted
scatter distribution at 600 nm

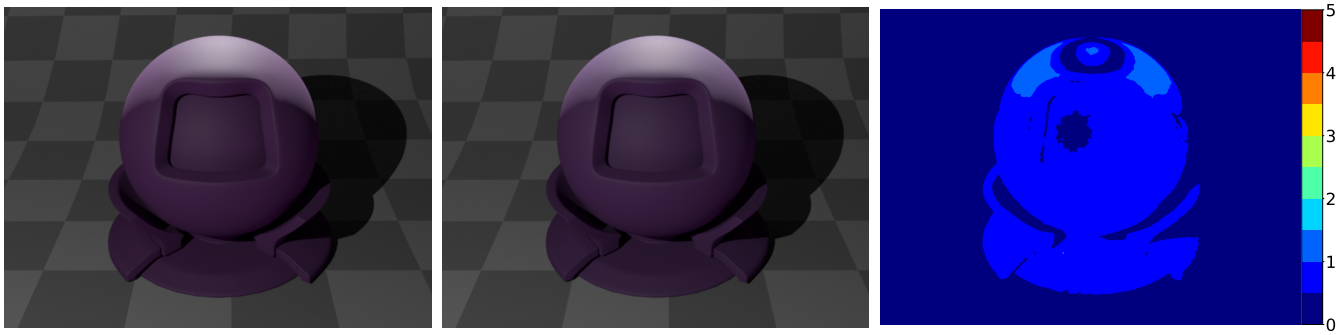




ColorChecker - Patch 10

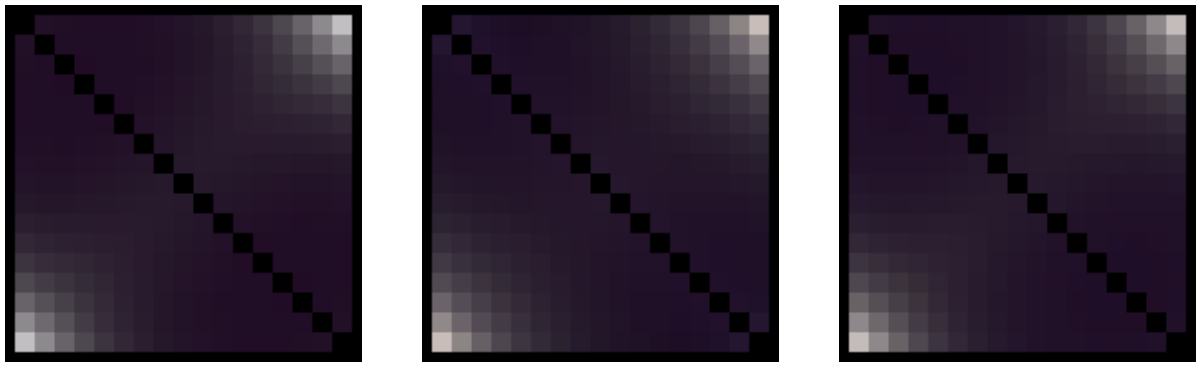
Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000



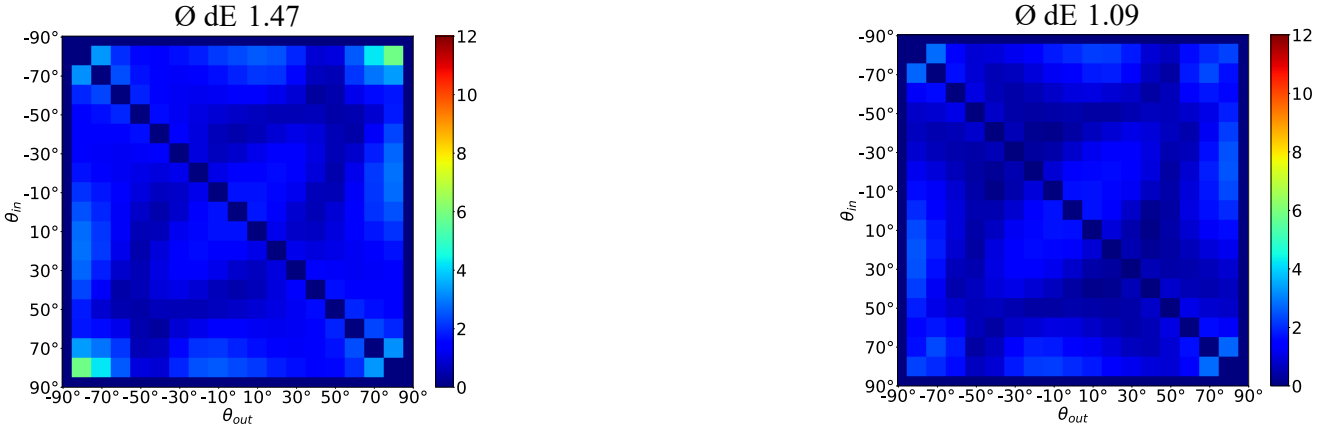
rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our



dE 2000

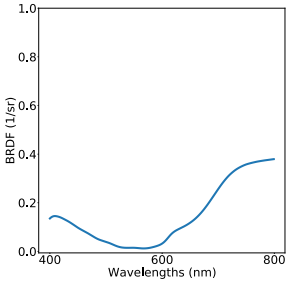
Ø dE 1.47 | Ø dE 1.09



Fitting result

Cook-Torrance GGX

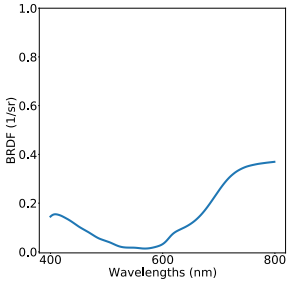
diffuse albedo



alpha = 0.5021
n_ior = 1.6031

Our

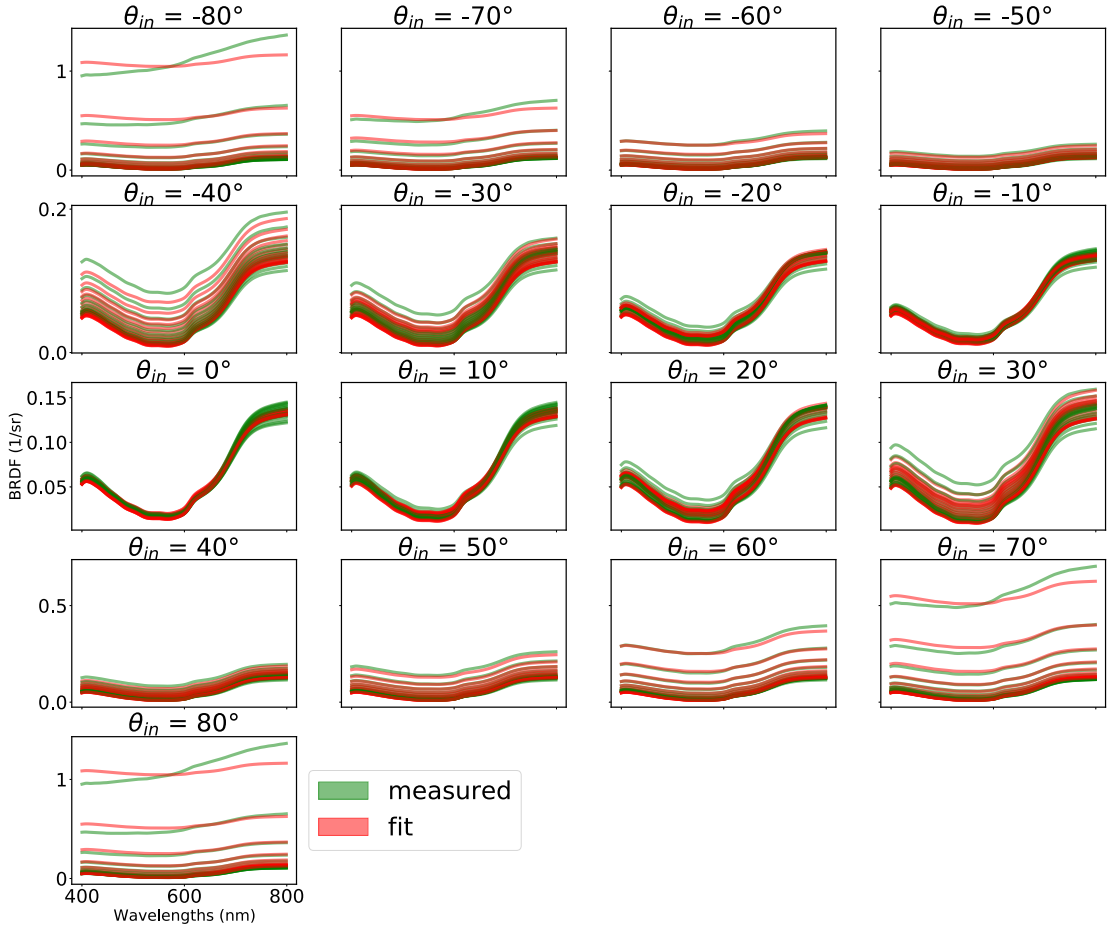
diffuse albedo



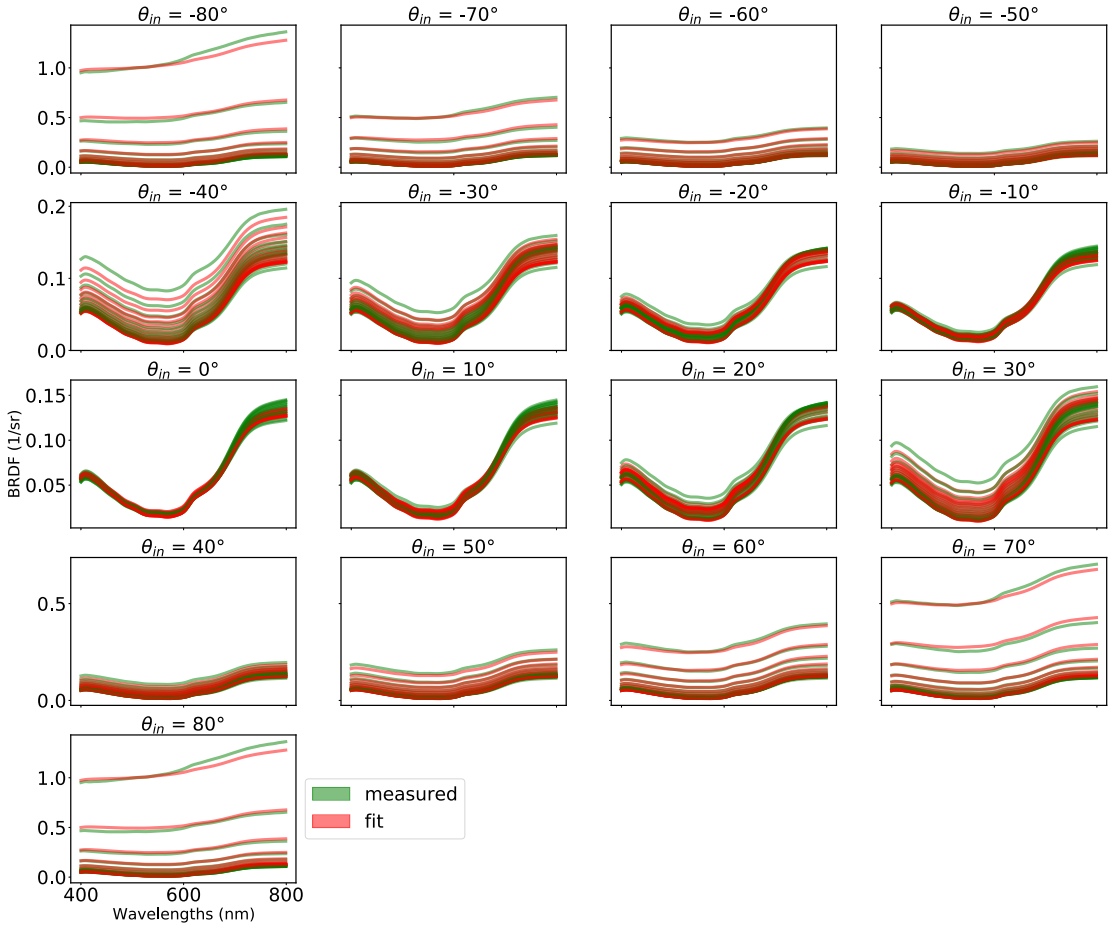
alpha = 0.5019
n_ior = 1.6039
height = 5.60E-04
width = 4.1650

Measured vs. fitted spectra

Cook-Torrance GGX

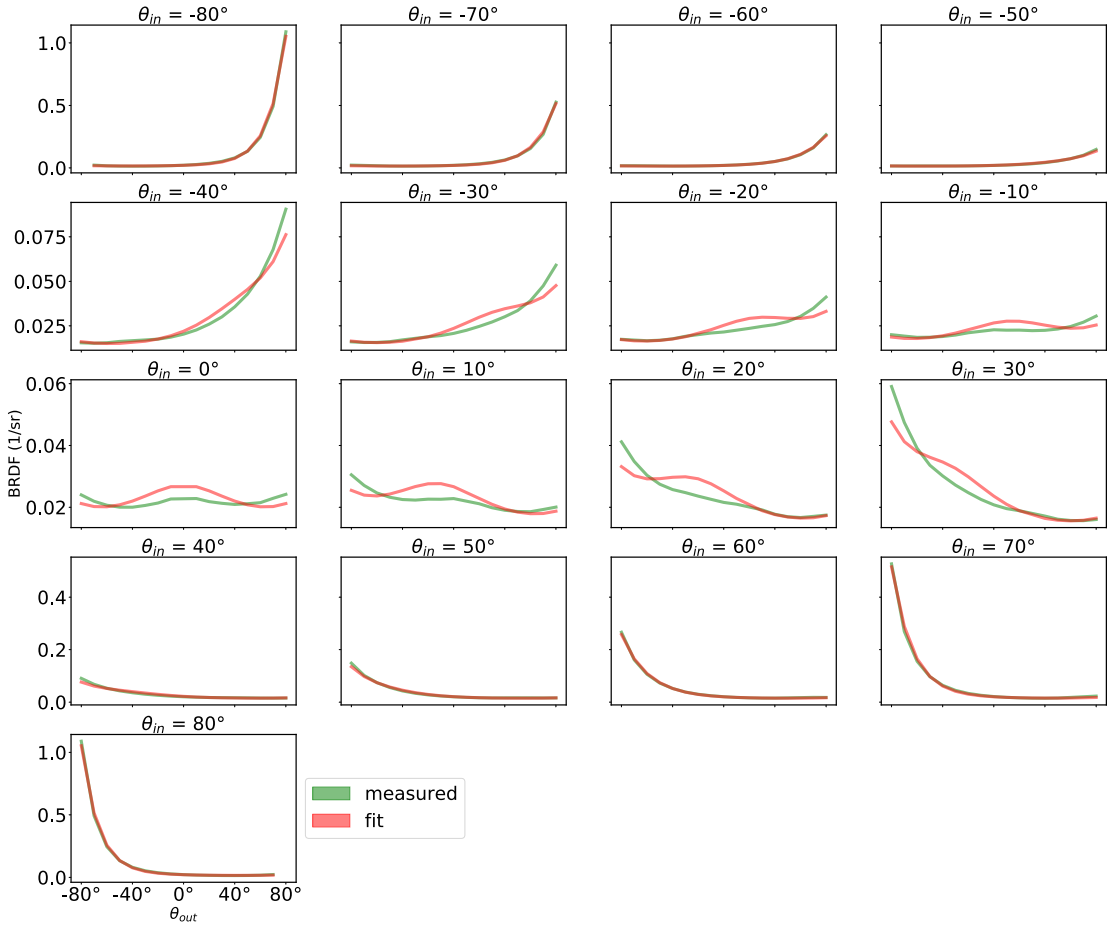


Our

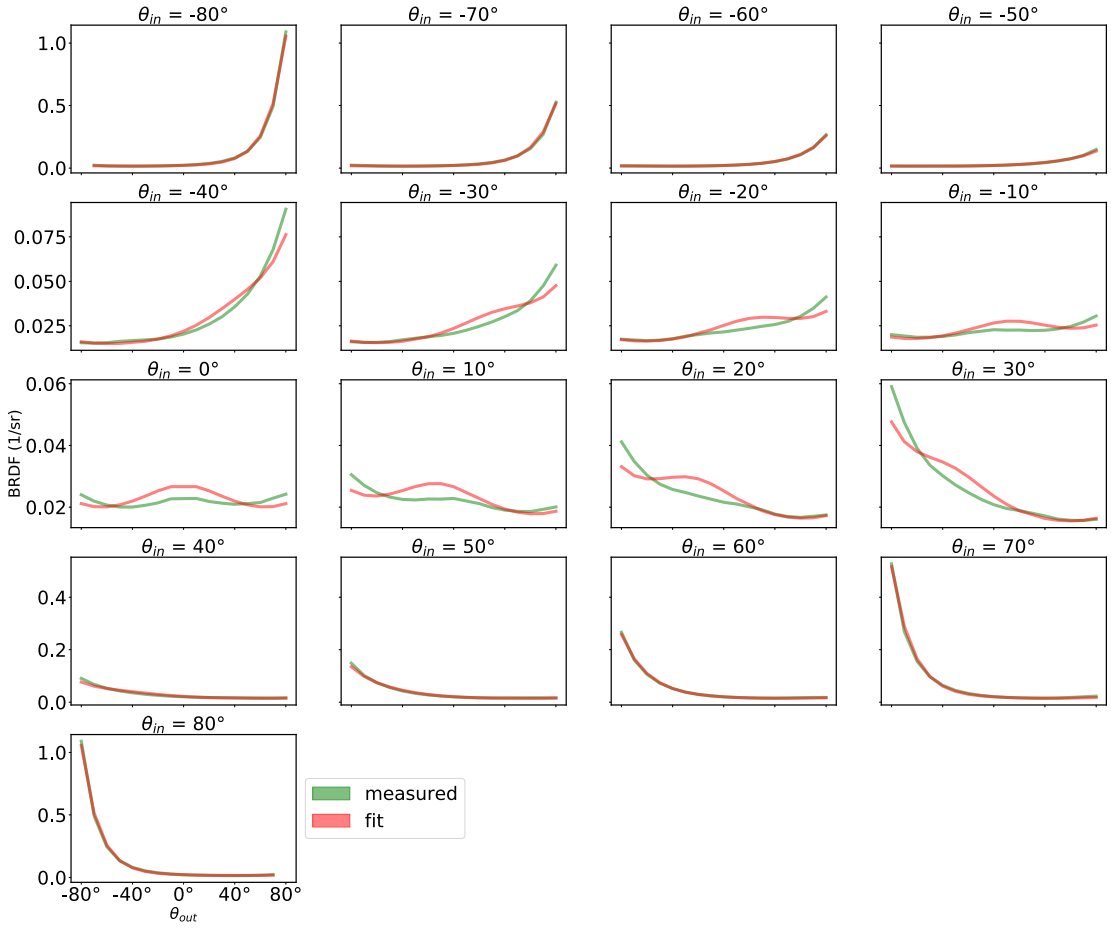


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



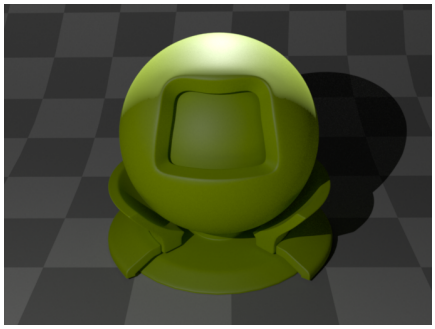
Our



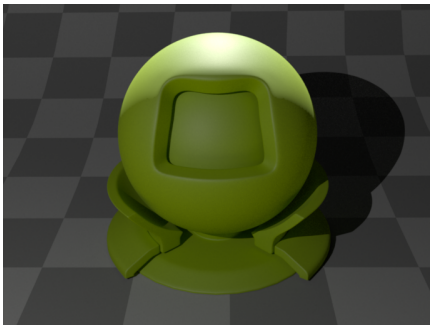
ColorChecker - Patch 11

Rendering
(Computed with Mitsuba 2)

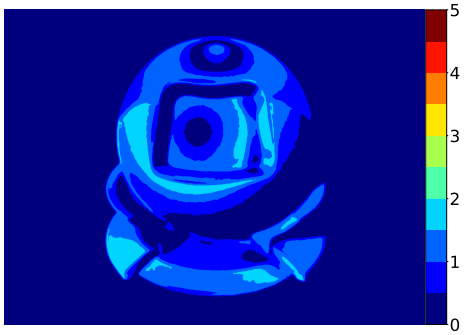
Cook-Torrance GGX



Our

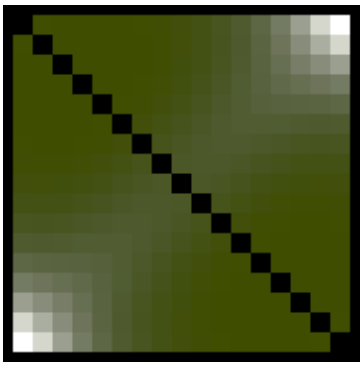


dE 2000

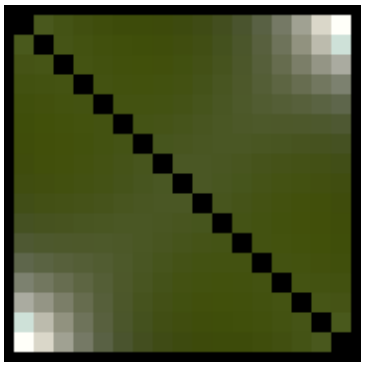


rgb image of
in-plane BRDF

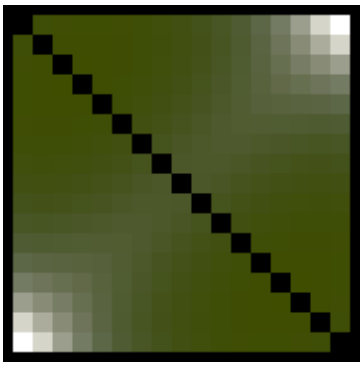
Cook-Torrance GGX



Measurement

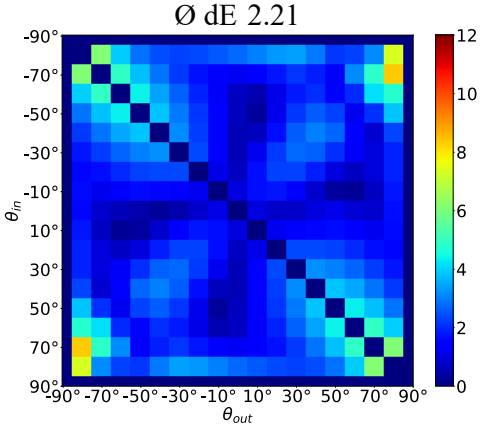


Our

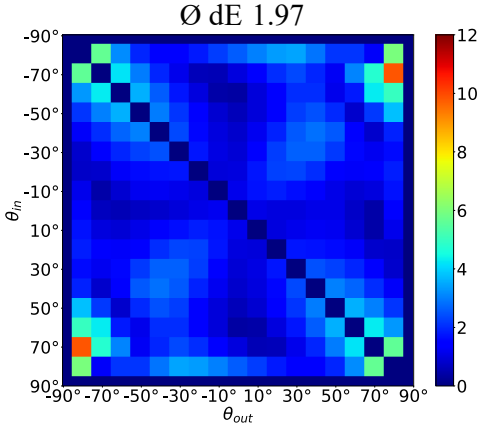


dE 2000

Ø dE 2.21



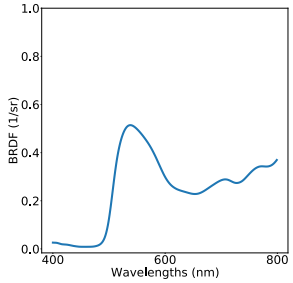
Ø dE 1.97



Fitting result

Cook-Torrance GGX

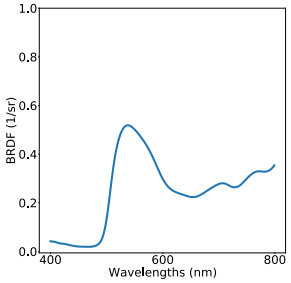
diffuse albedo



alpha = 0.3833
n_ior = 1.9263

Our

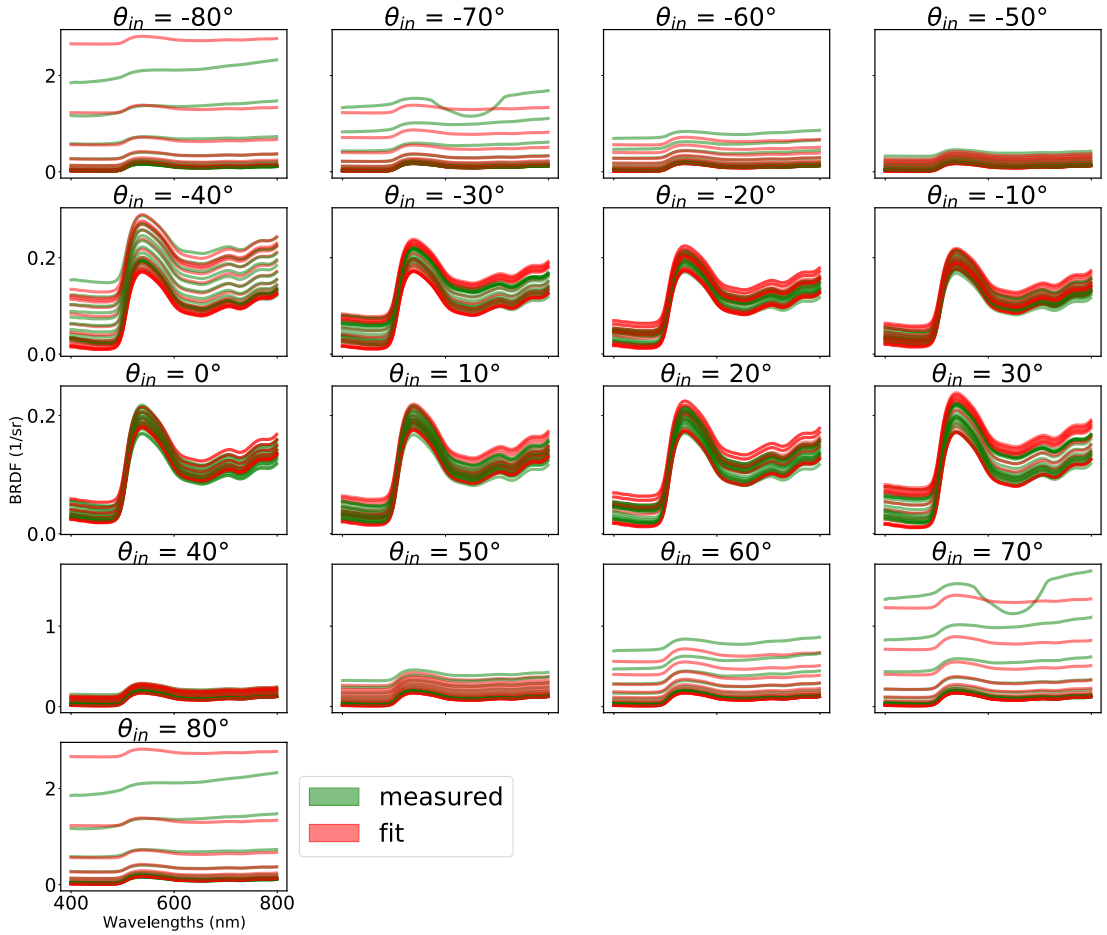
diffuse albedo



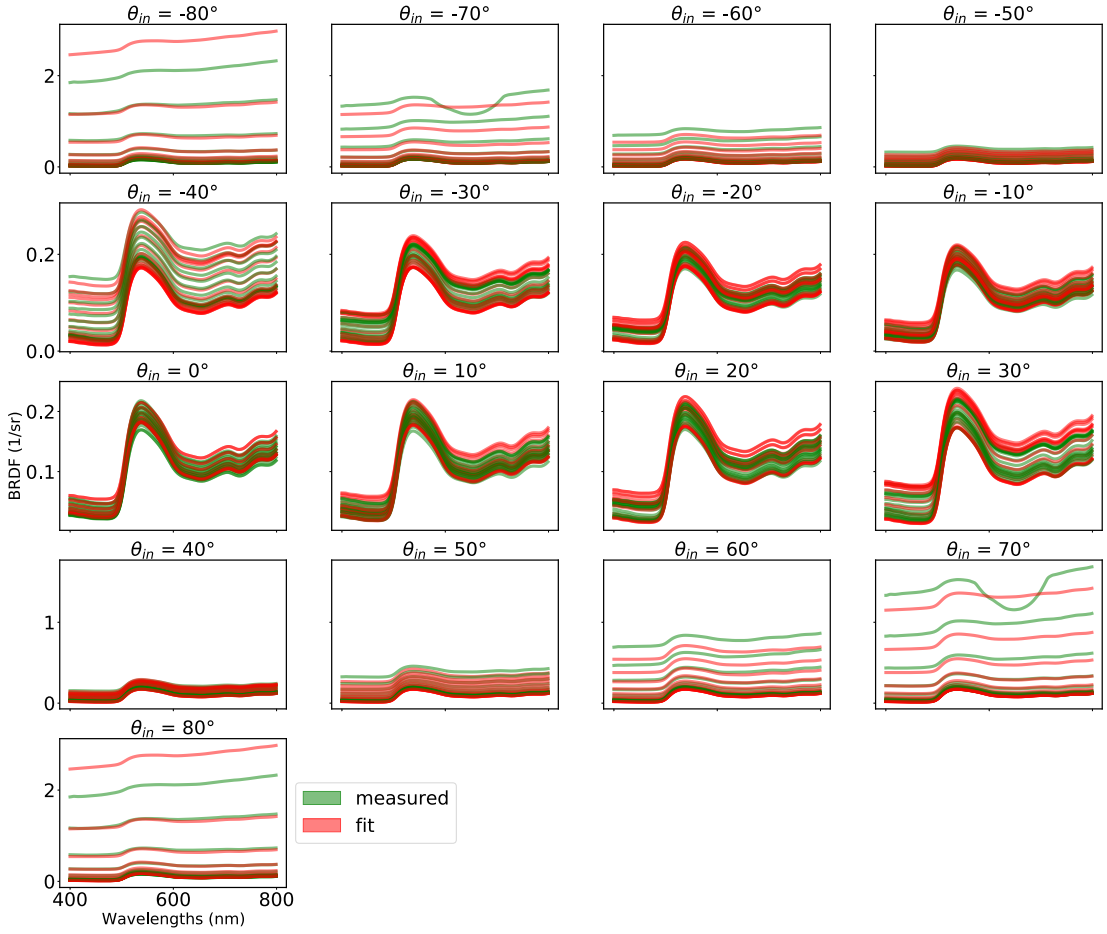
alpha = 0.3831
n_ior = 1.9269
height = 3.95E-04
width = 5.4288

Measured vs. fitted spectra

Cook-Torrance GGX

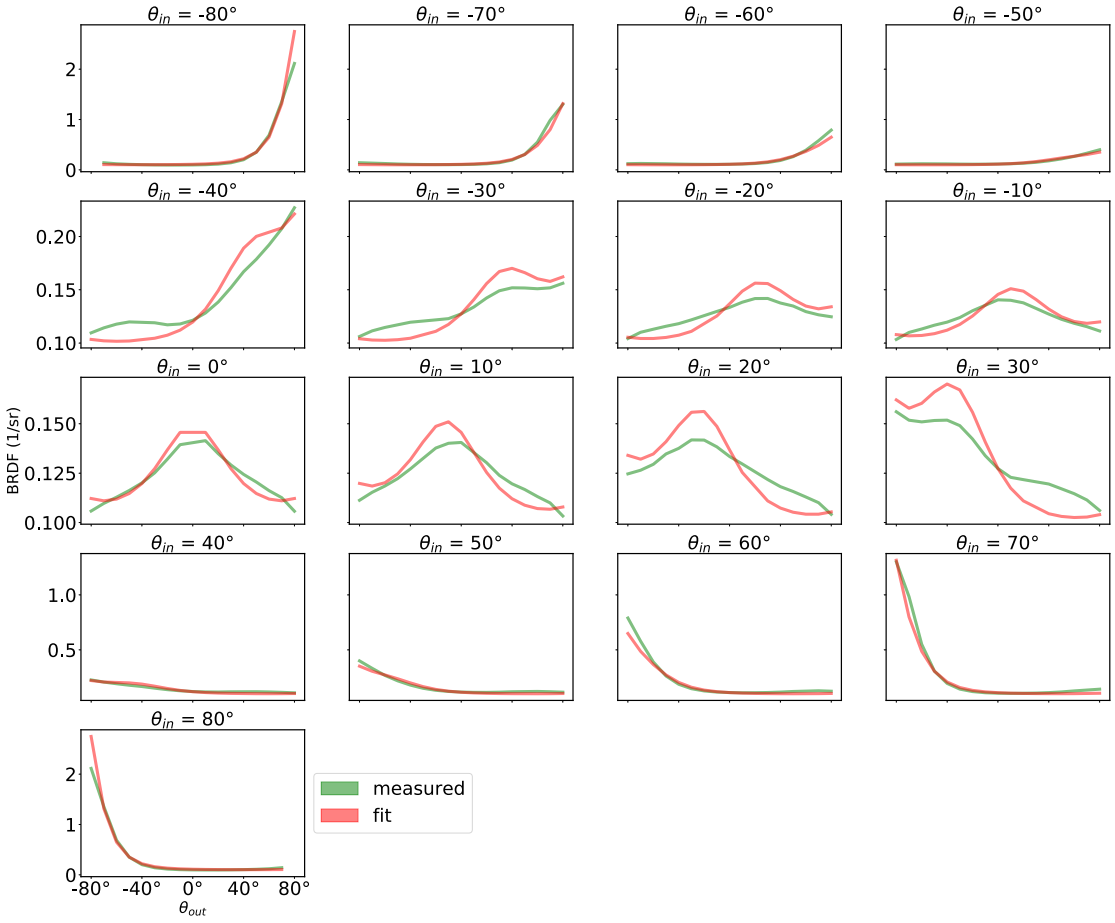


Our

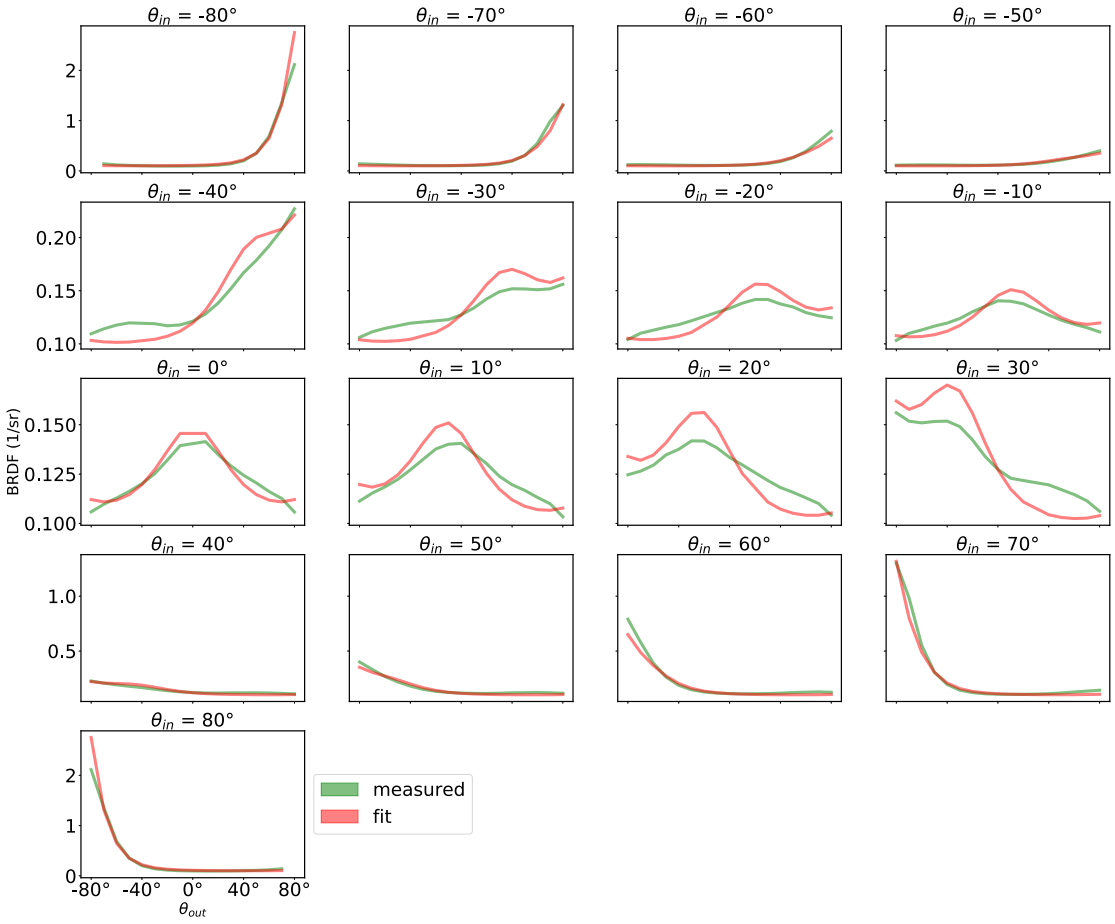


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

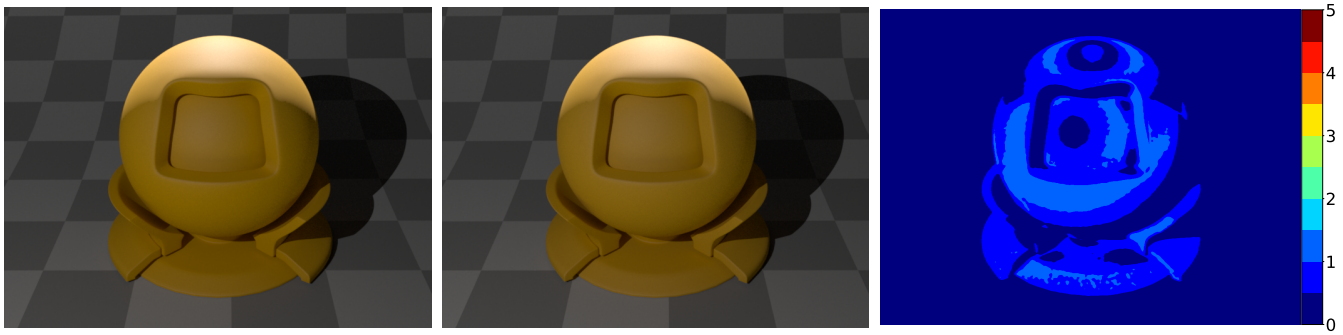


Our

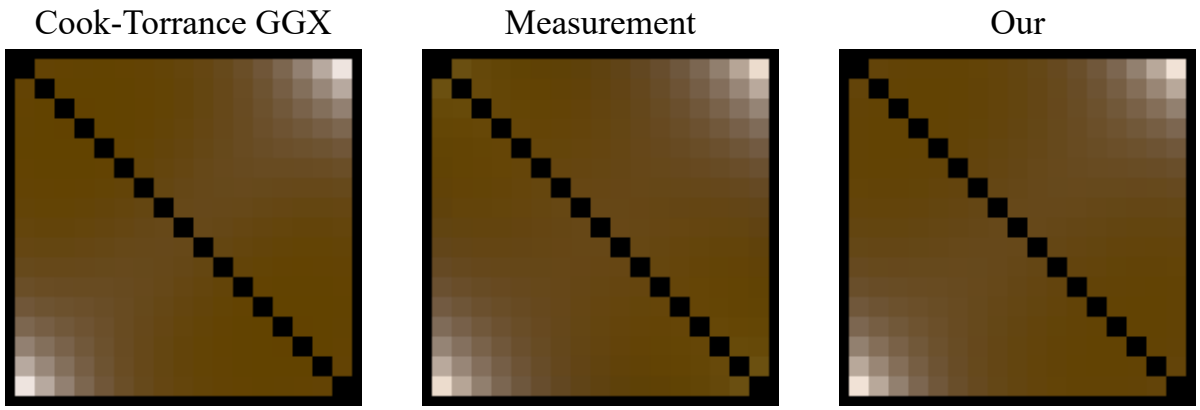


ColorChecker - Patch 12

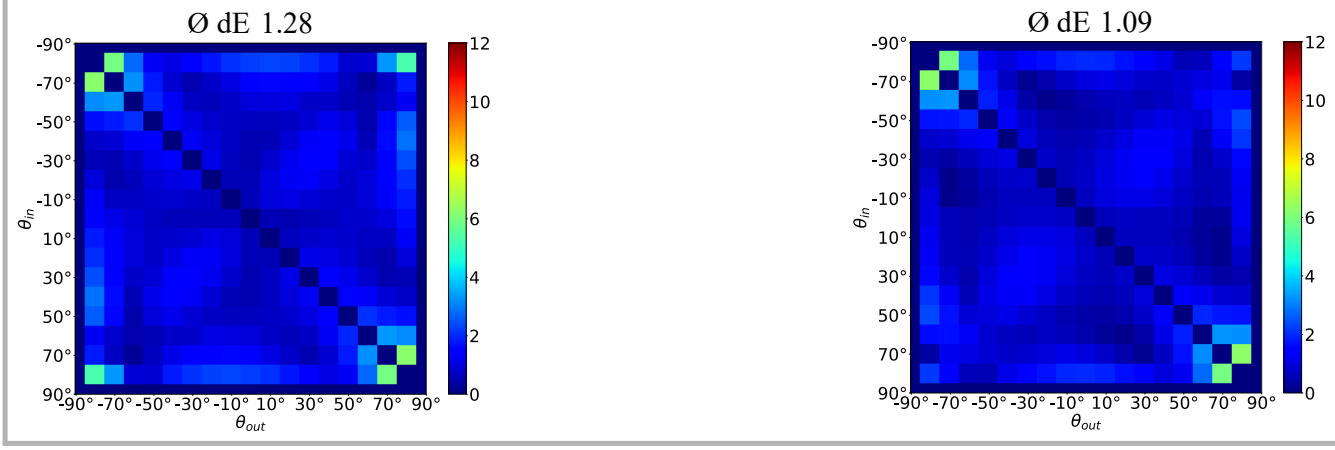
Rendering (Computed with Mitsuba 2)



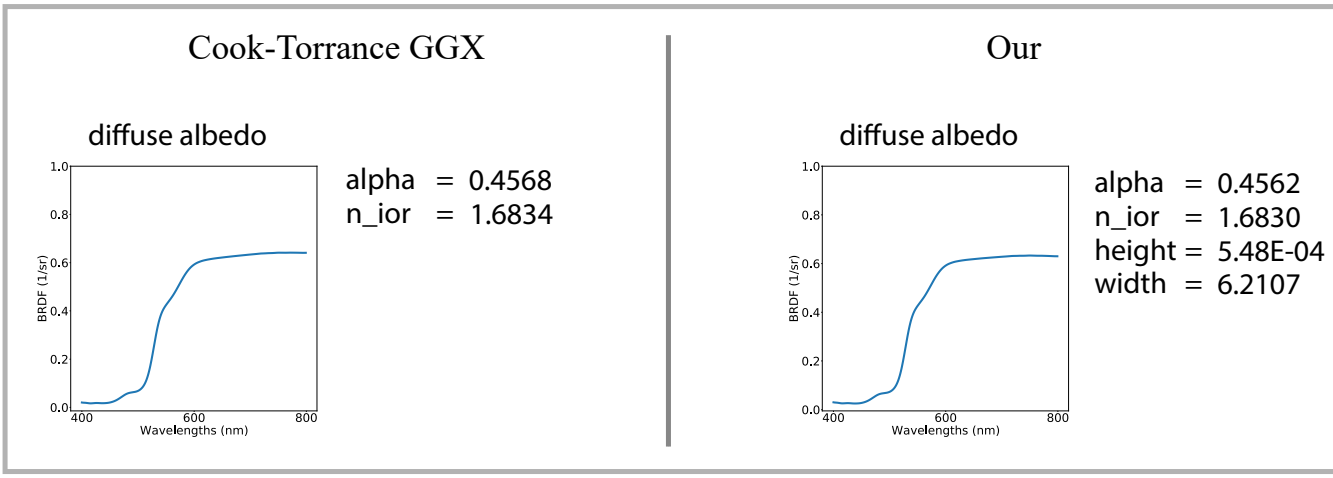
rgb image of in-plane BRDF



dE 2000

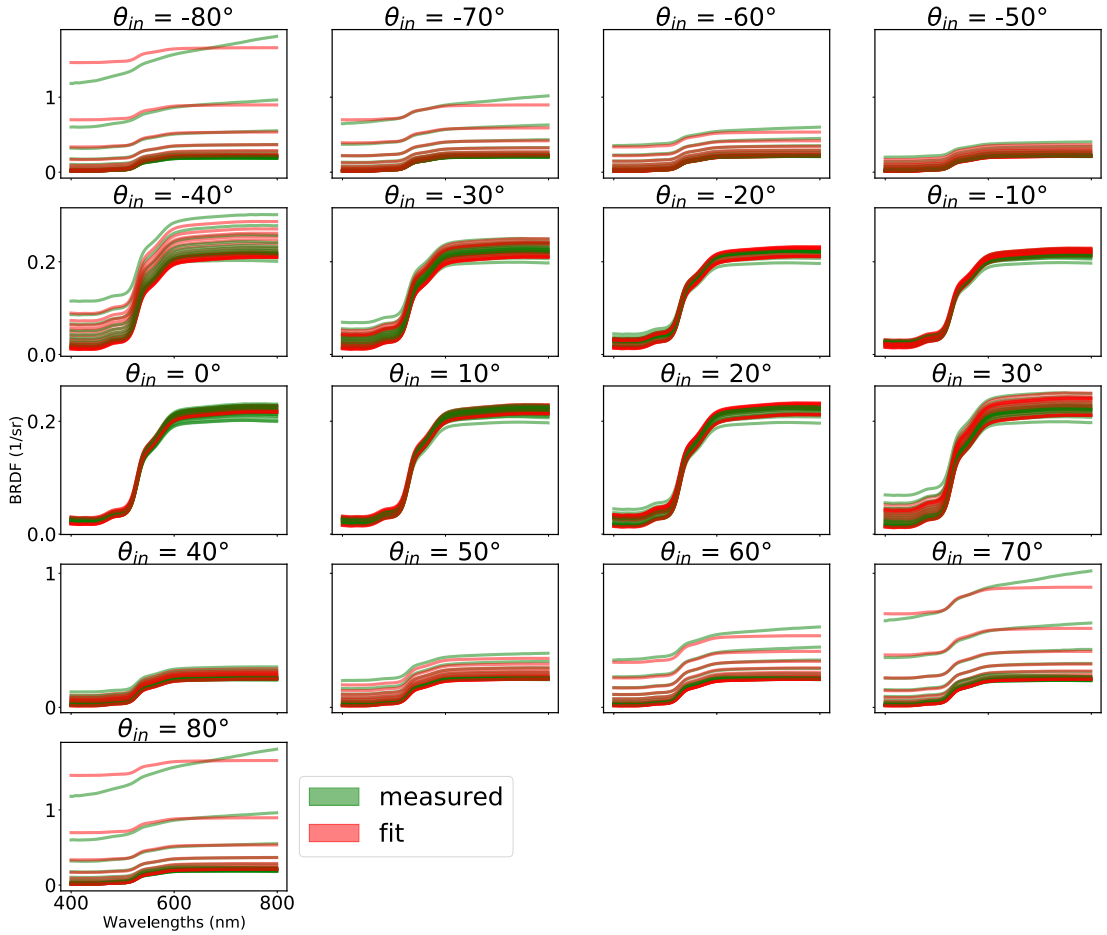


Fitting result

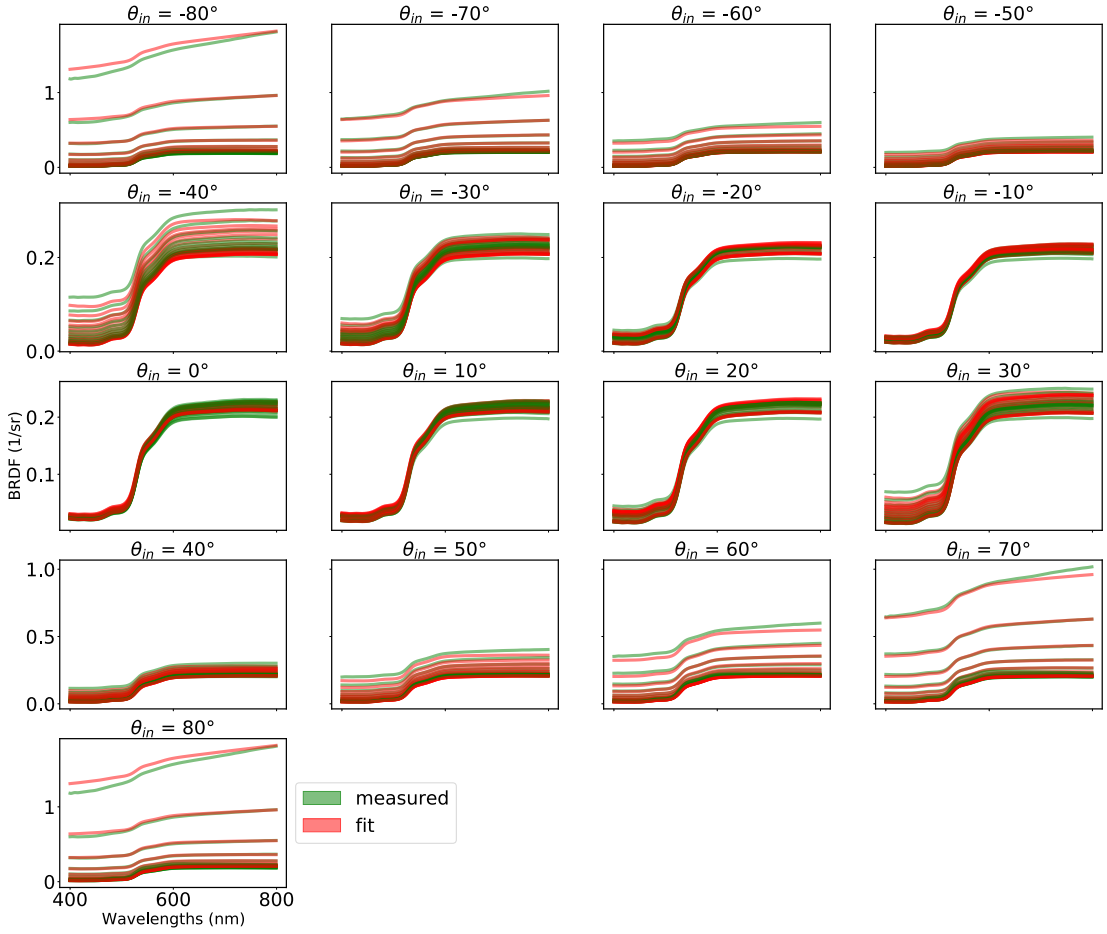


Measured vs. fitted spectra

Cook-Torrance GGX

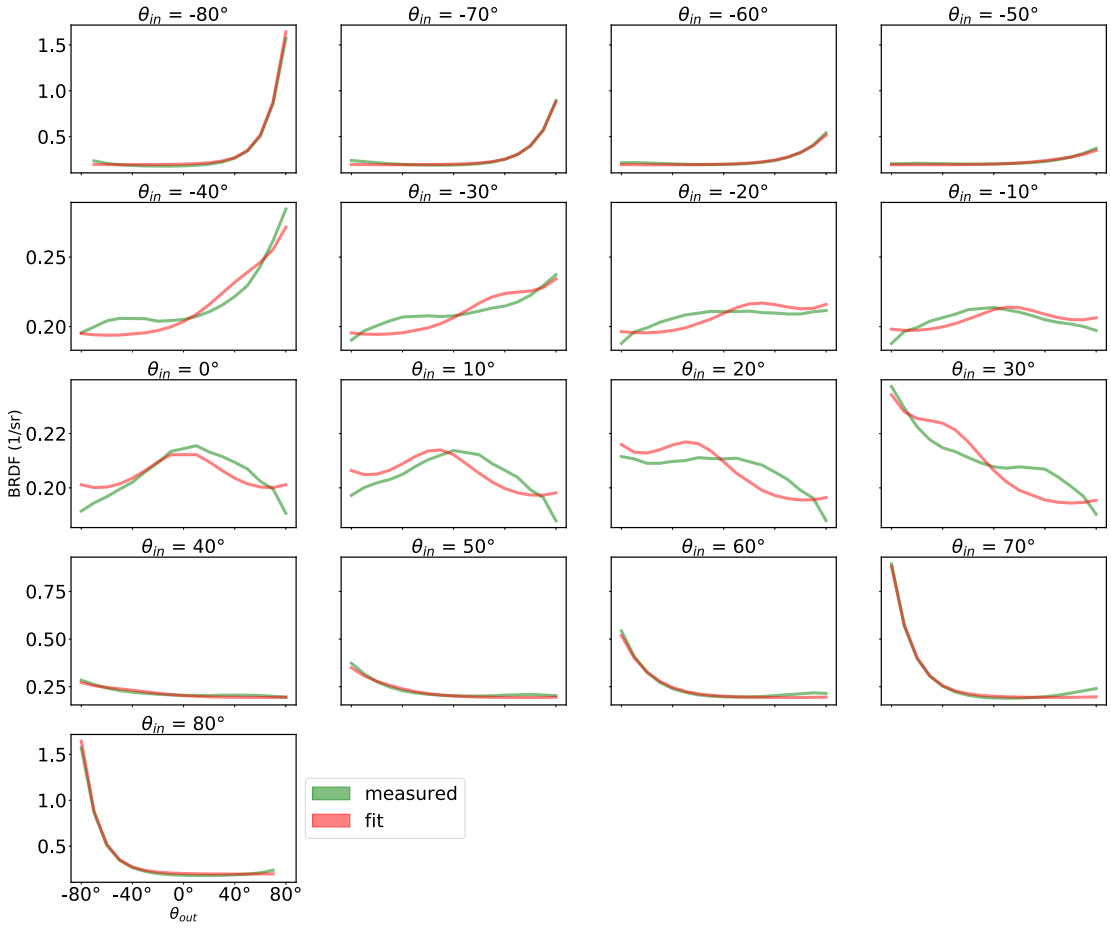


Our

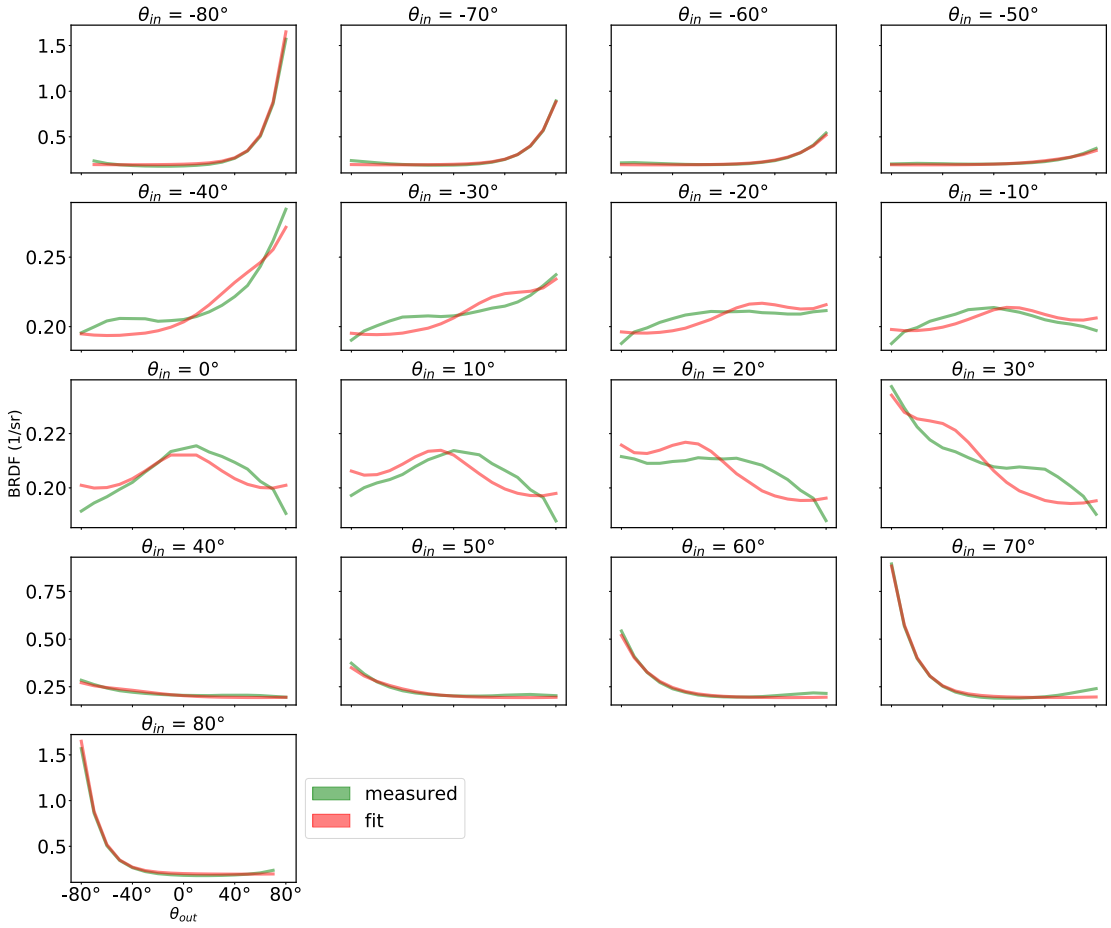


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



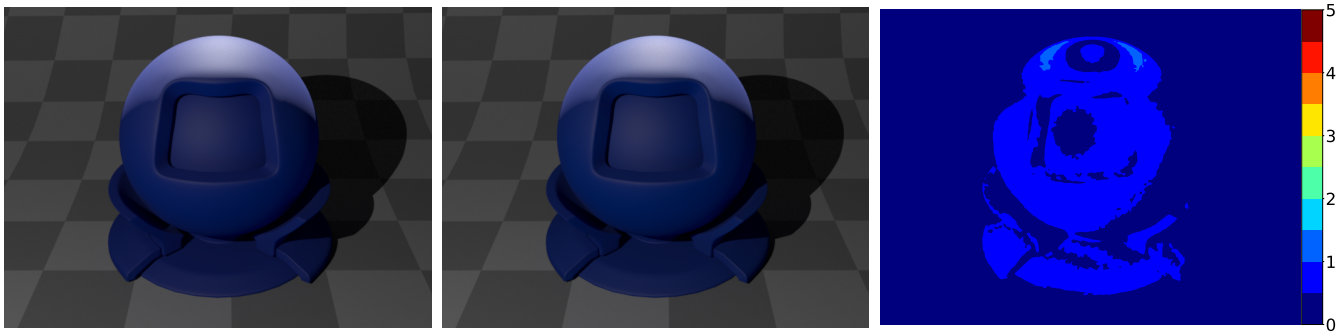
Our



ColorChecker - Patch 13

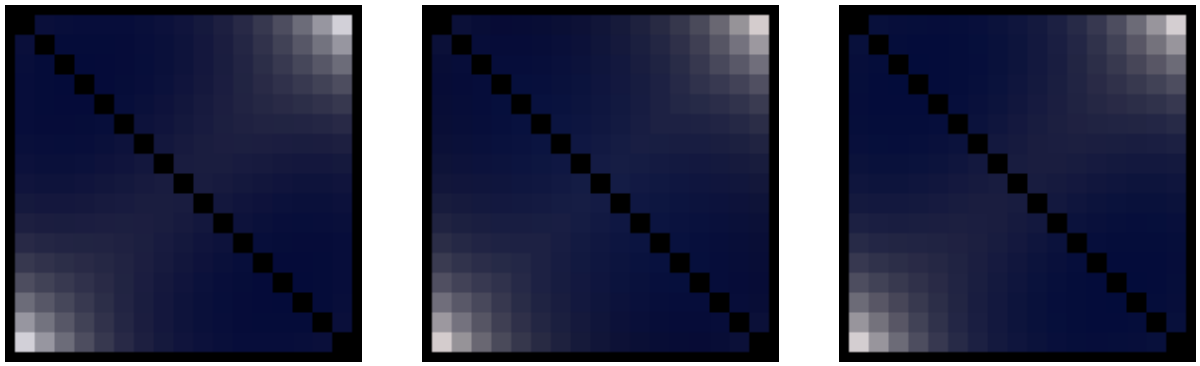
Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000



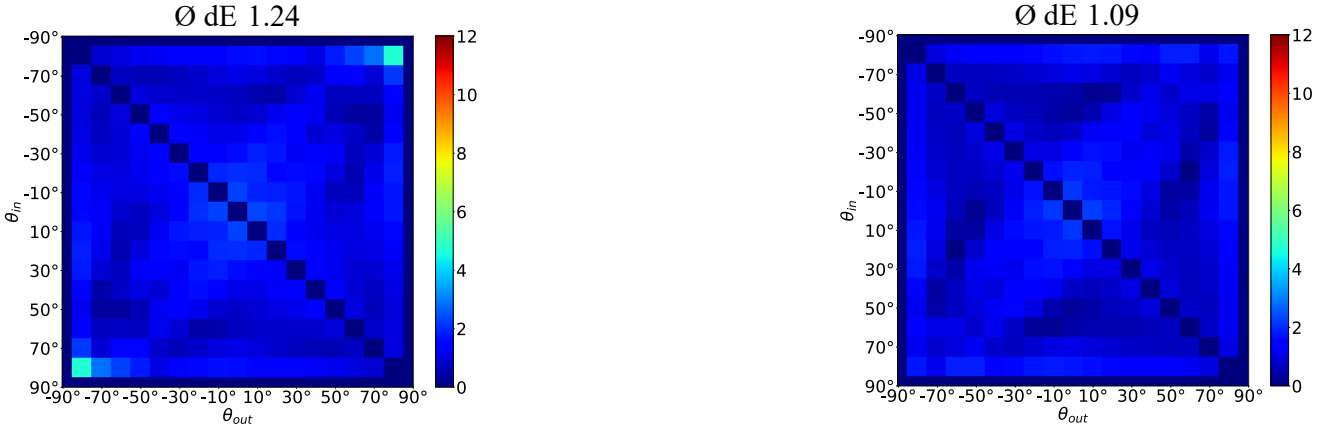
rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our



dE 2000

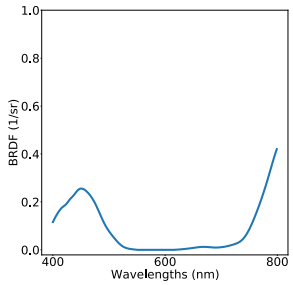
Ø dE 1.24 | Ø dE 1.09



Fitting result

Cook-Torrance GGX

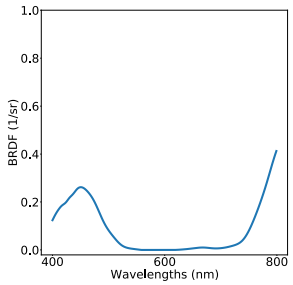
diffuse albedo



alpha = 0.4754
n_ior = 1.6743

Our

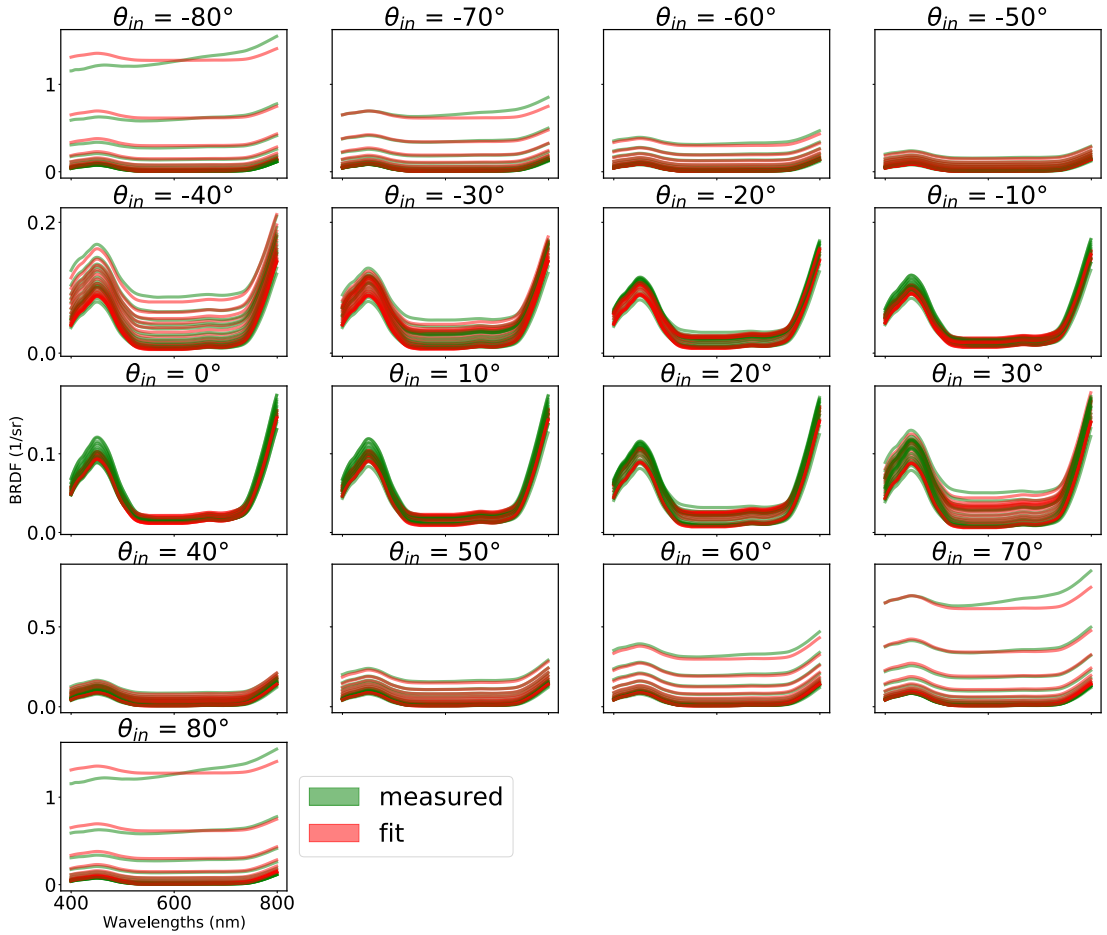
diffuse albedo



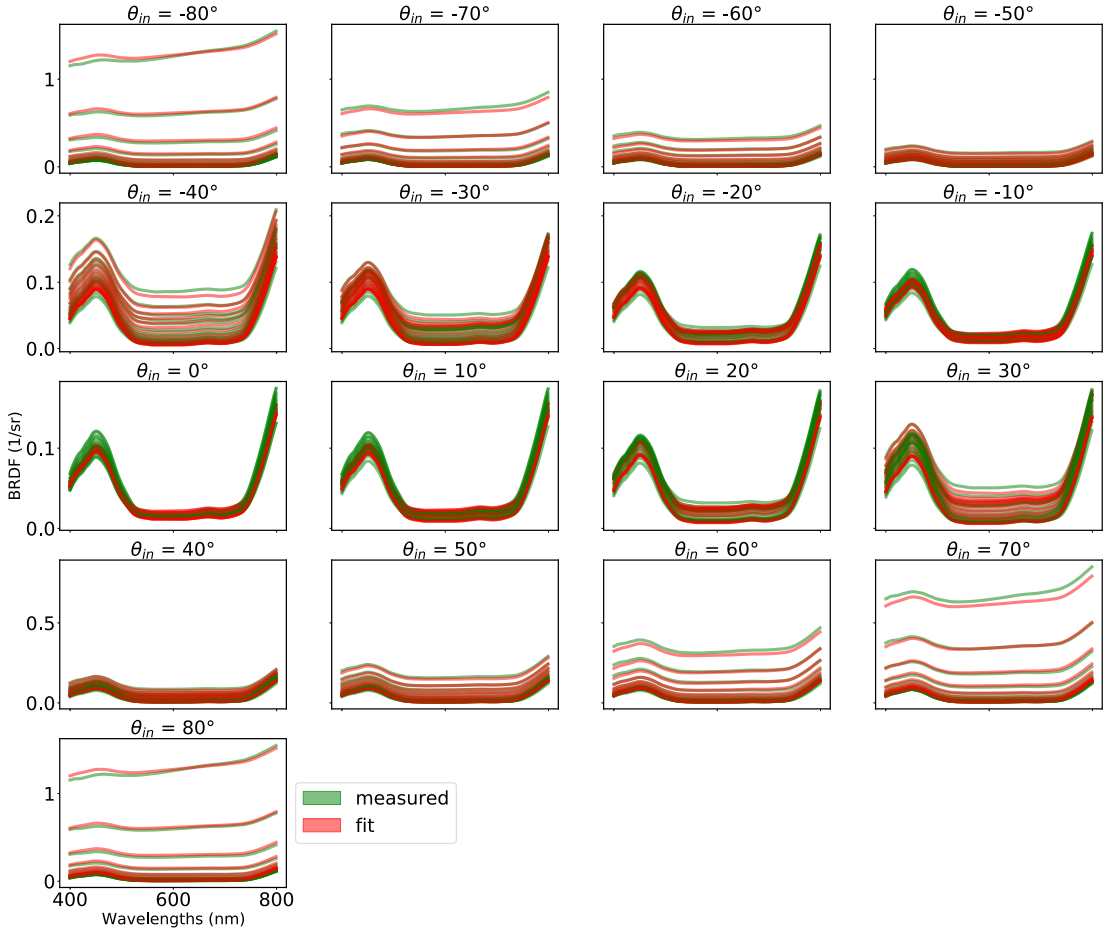
alpha = 0.4752
n_ior = 1.6719
height = 4.38E-04
width = 5.7602

Measured vs. fitted spectra

Cook-Torrance GGX

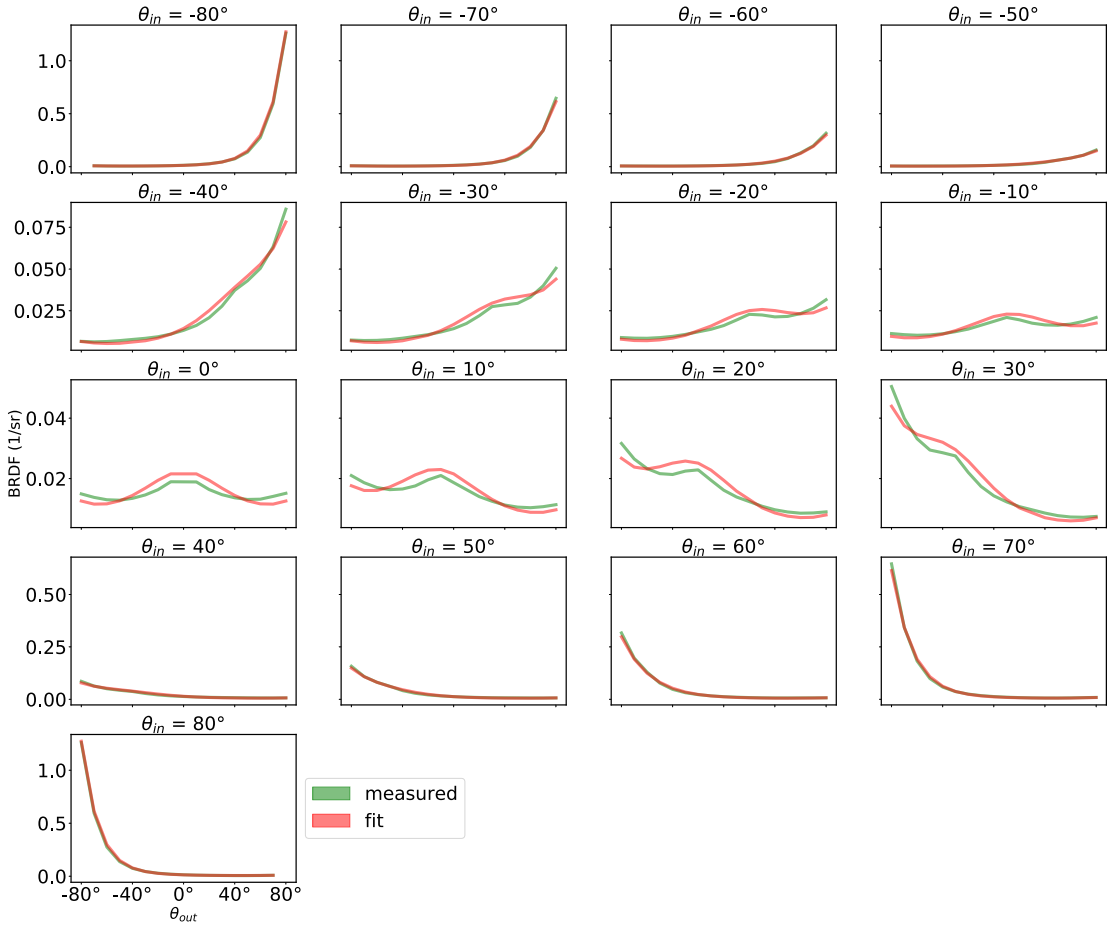


Our

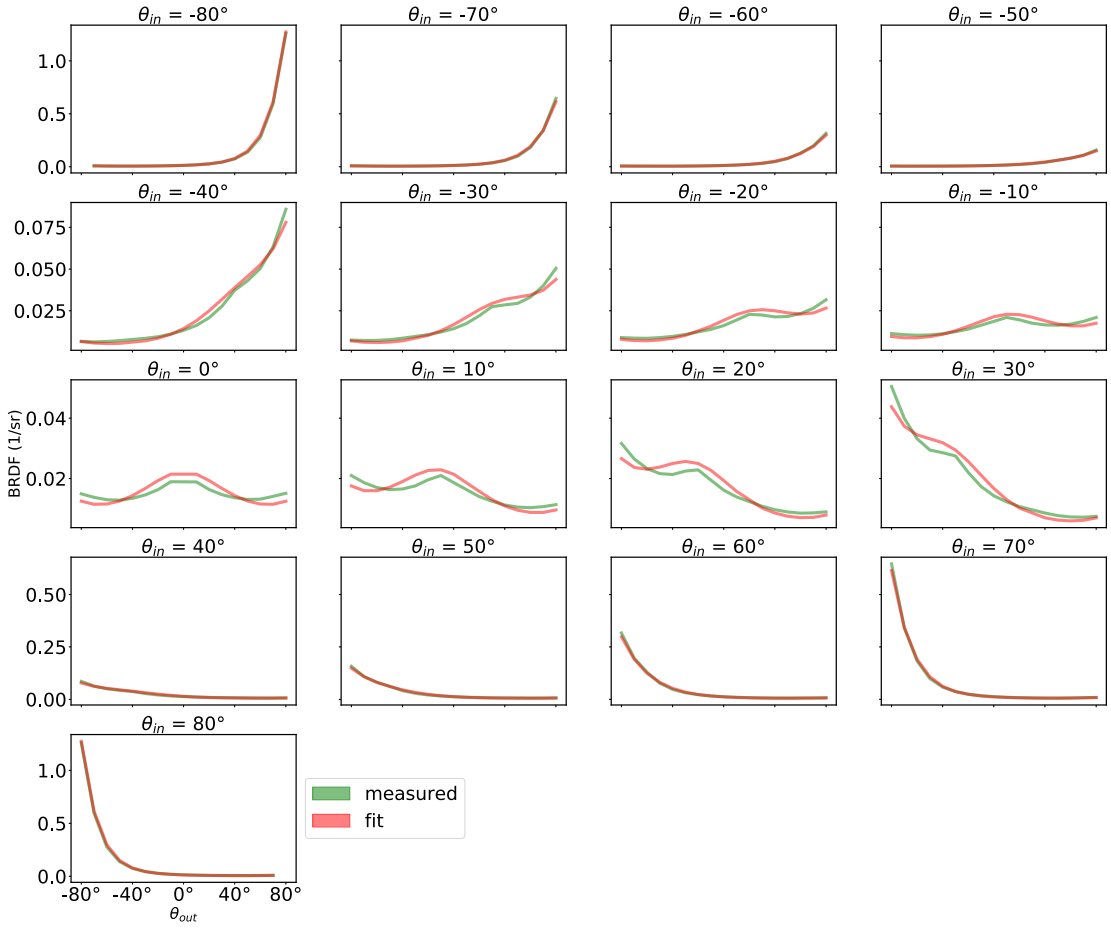


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

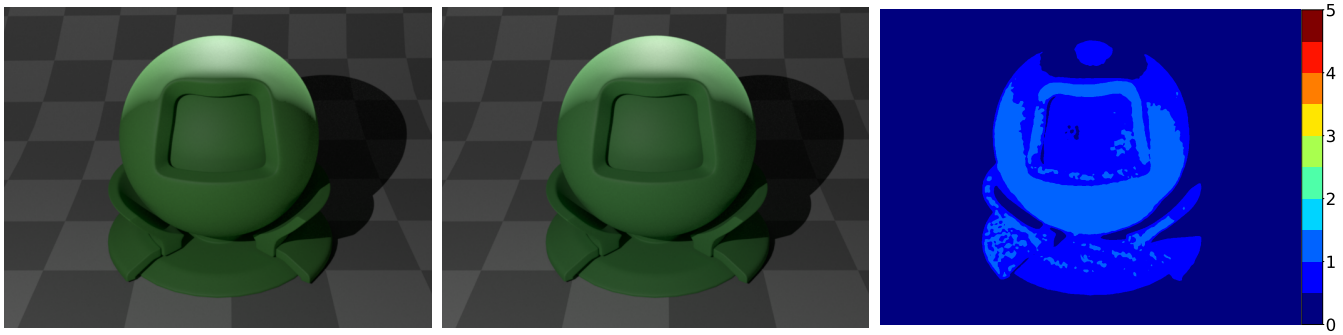


Our

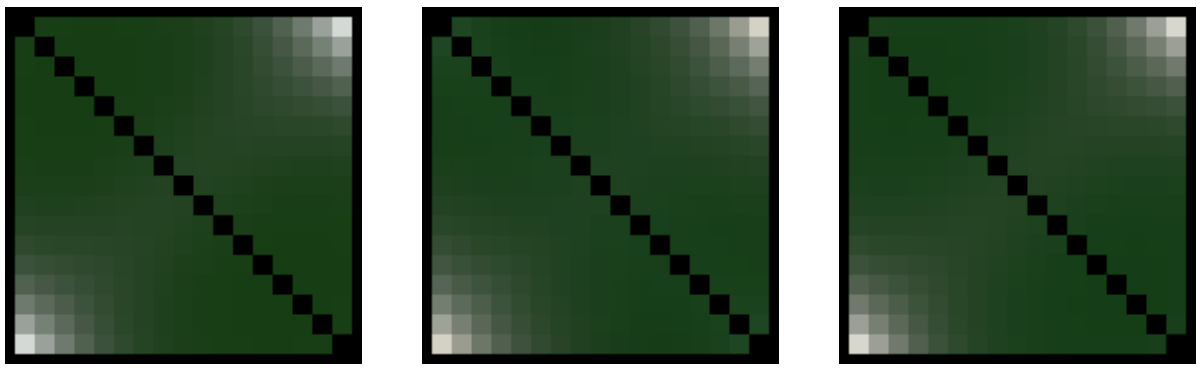


ColorChecker - Patch 14

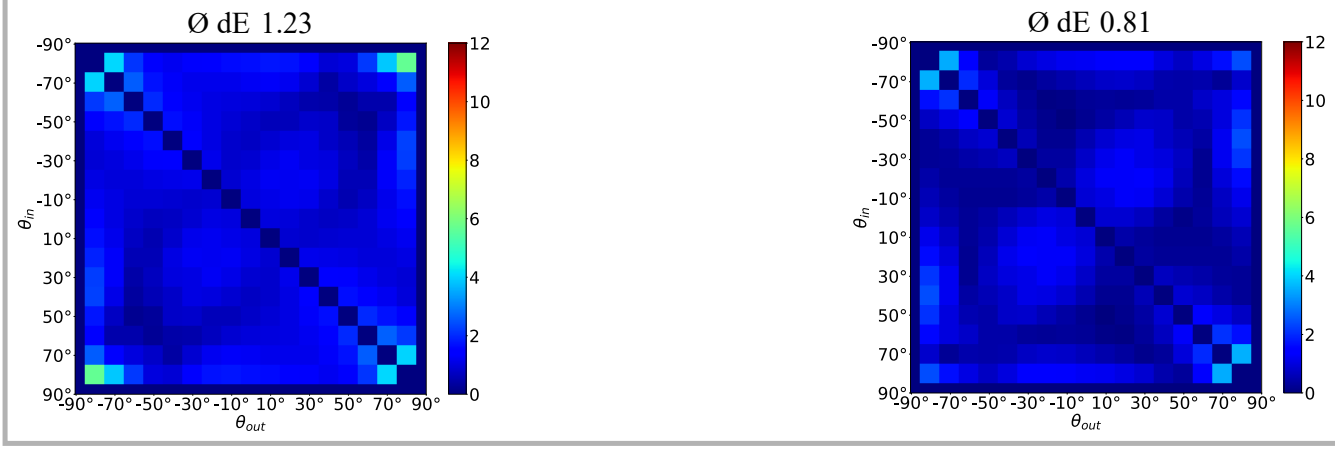
Rendering (Computed with Mitsuba 2)



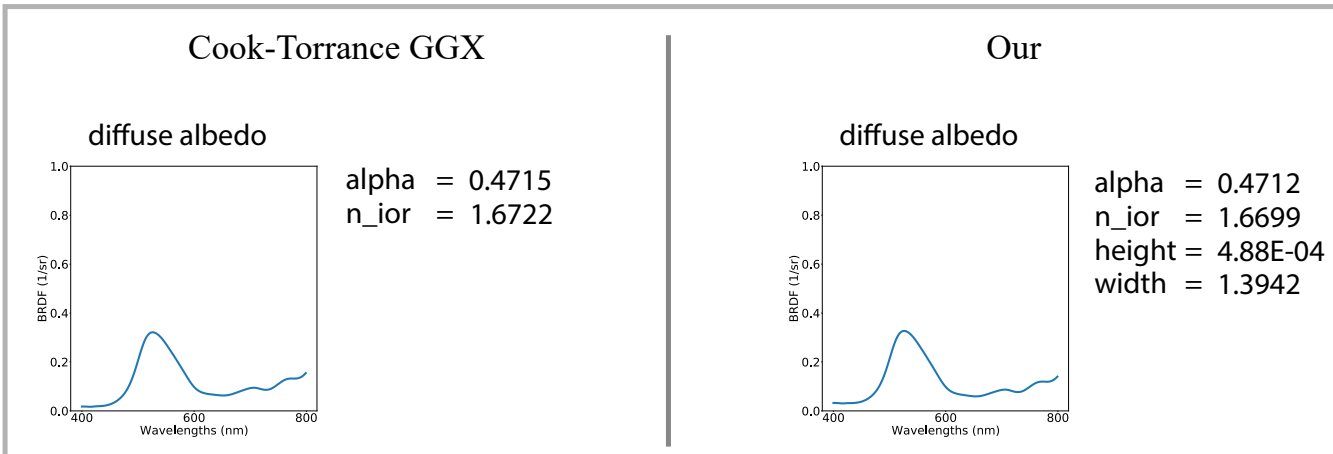
rgb image of in-plane BRDF



dE 2000

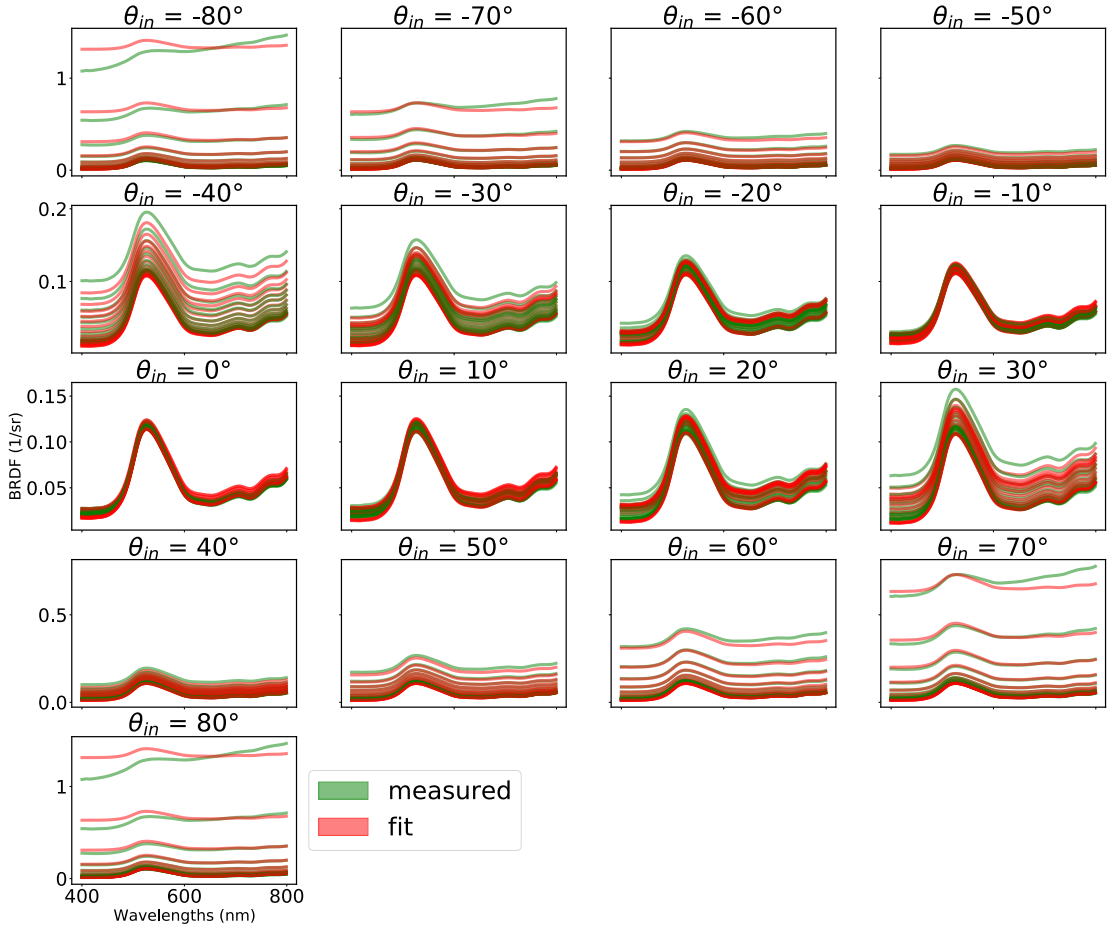


Fitting result

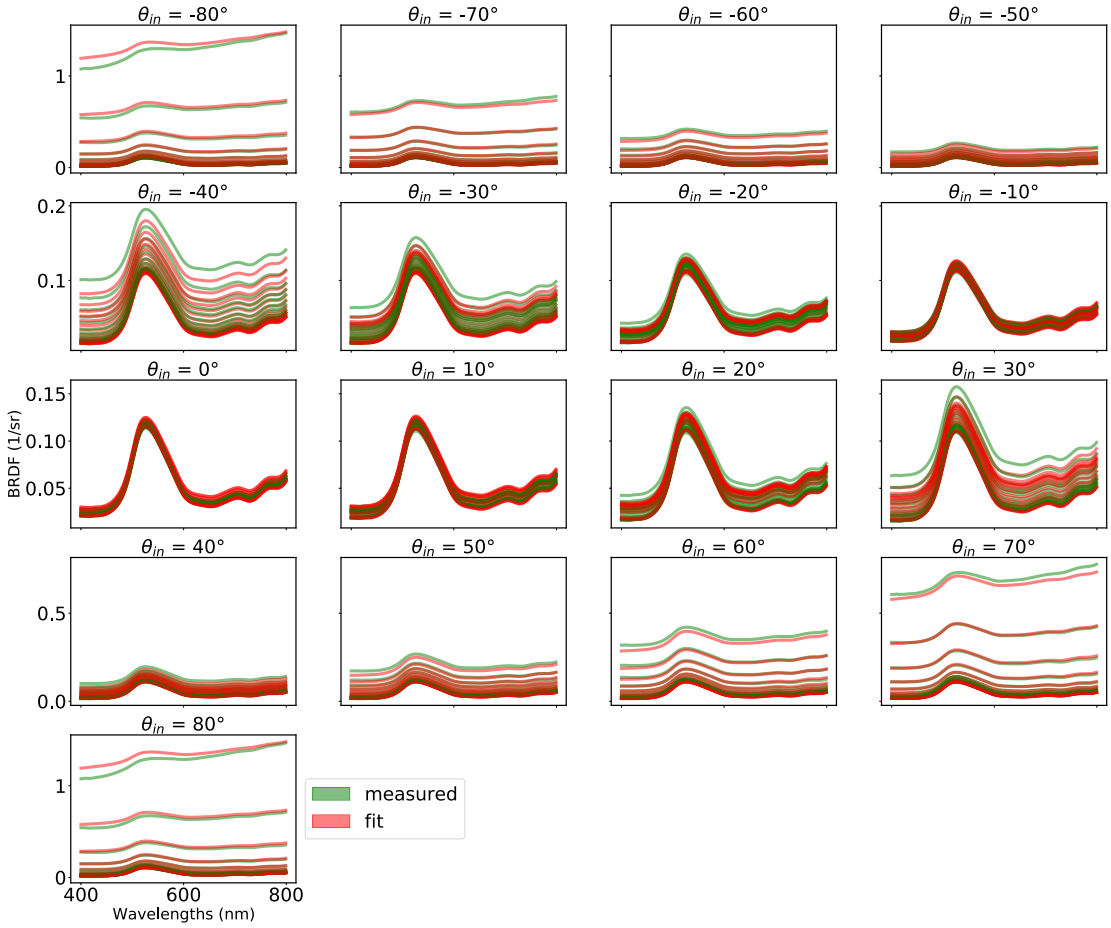


Measured vs. fitted spectra

Cook-Torrance GGX

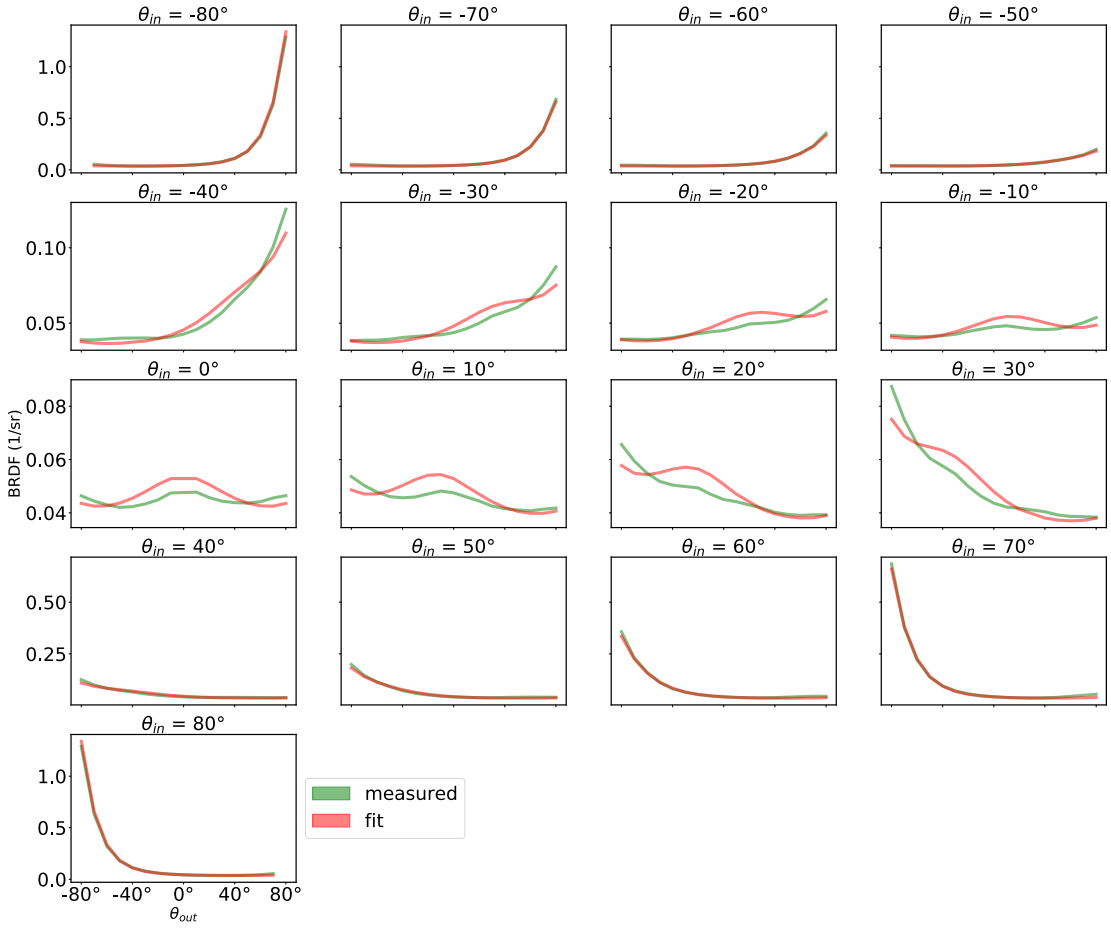


Our

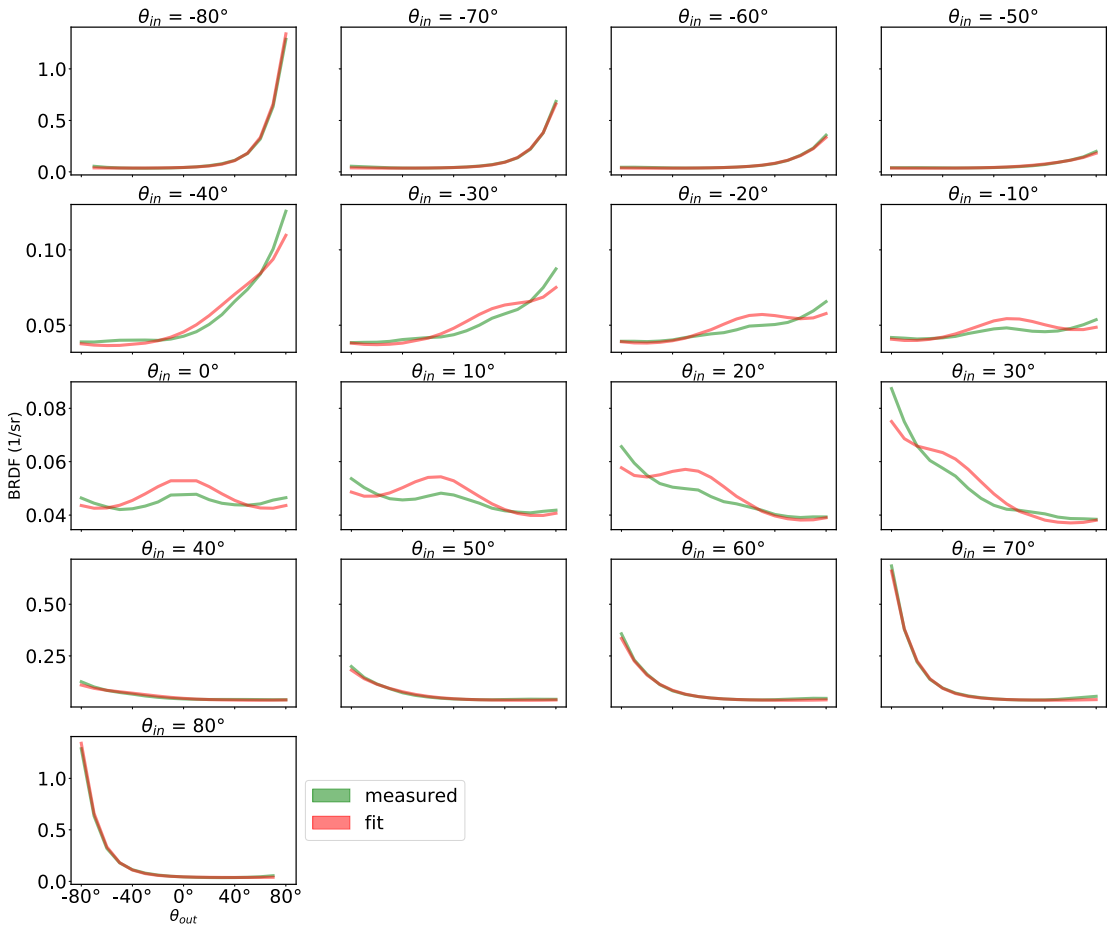


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

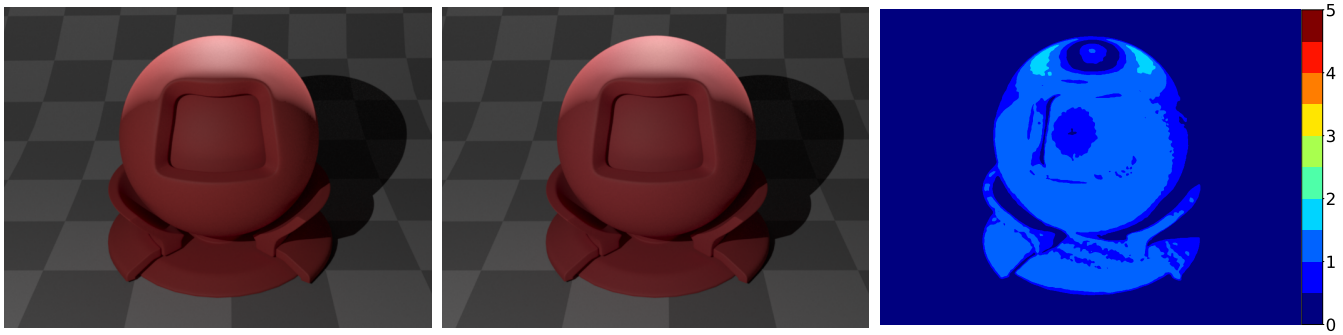


Our

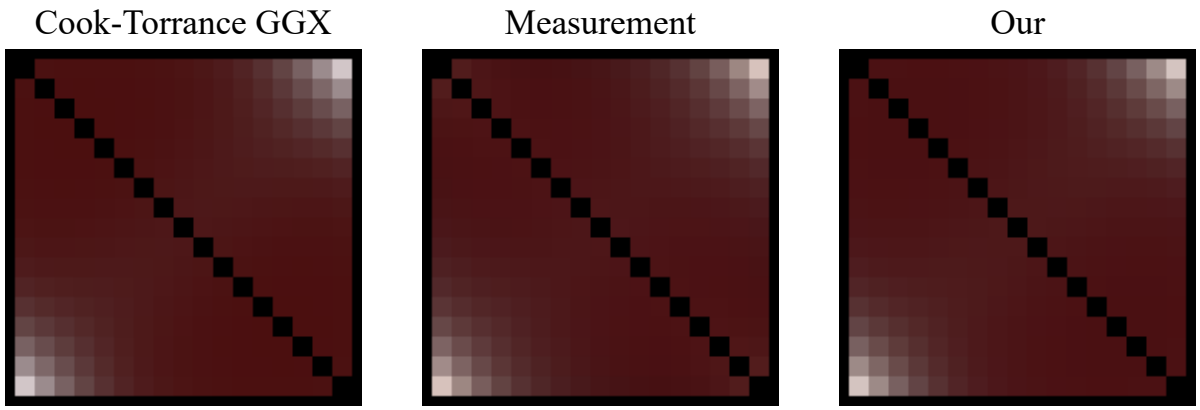


ColorChecker - Patch 15

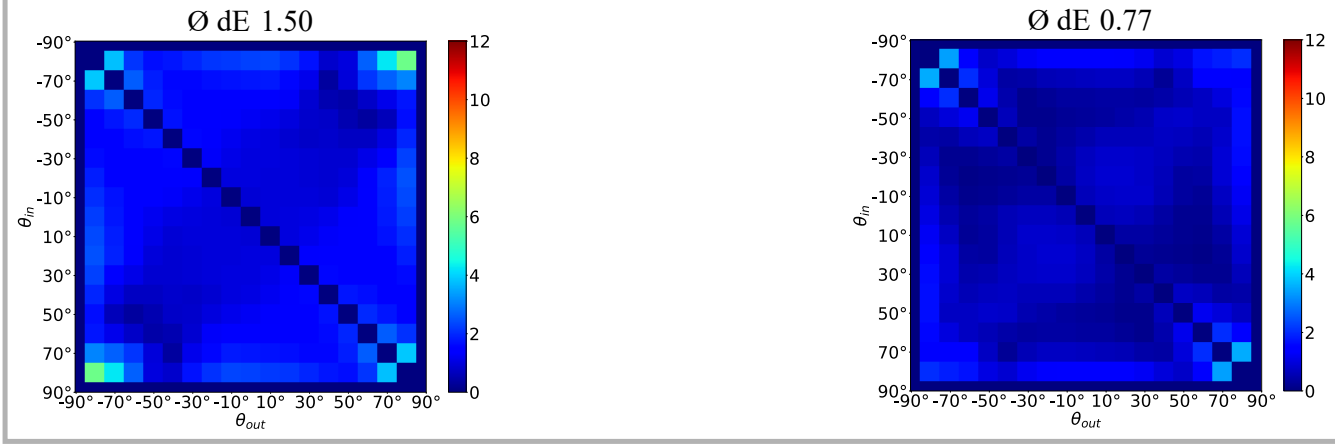
Rendering (Computed with Mitsuba 2)



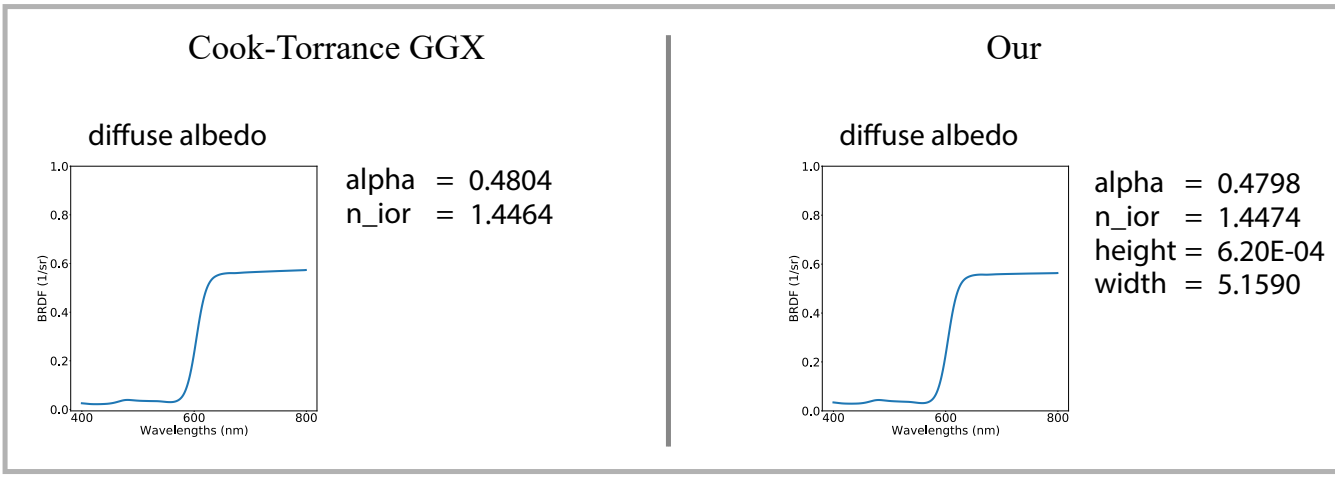
rgb image of in-plane BRDF



dE 2000

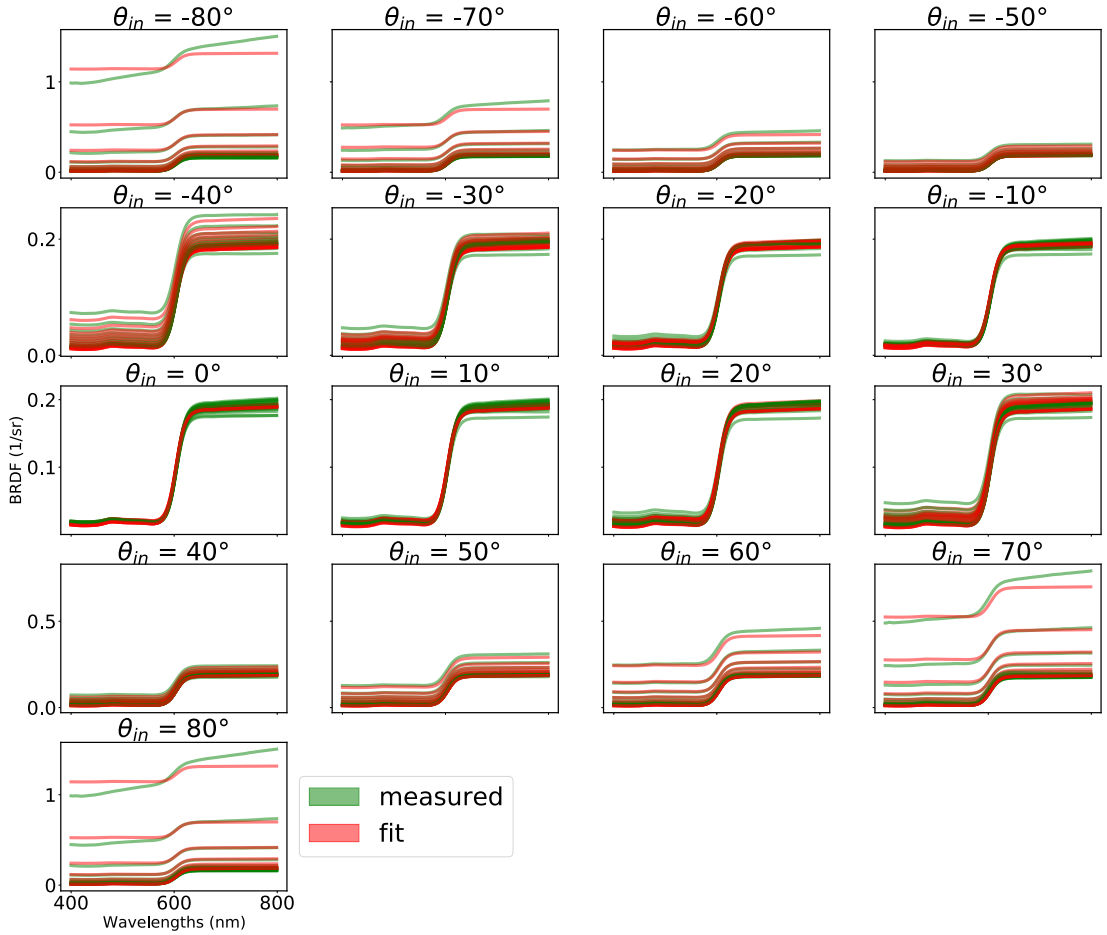


Fitting result

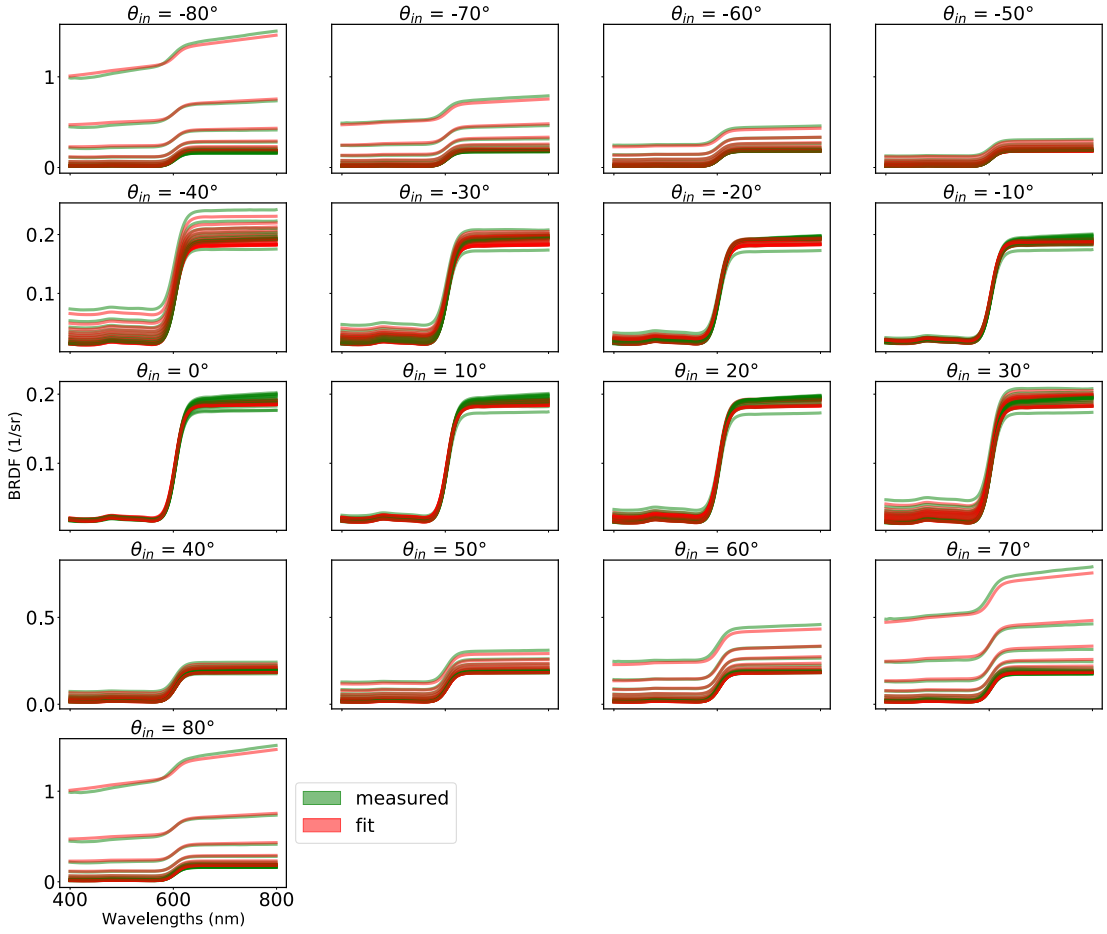


Measured vs. fitted spectra

Cook-Torrance GGX

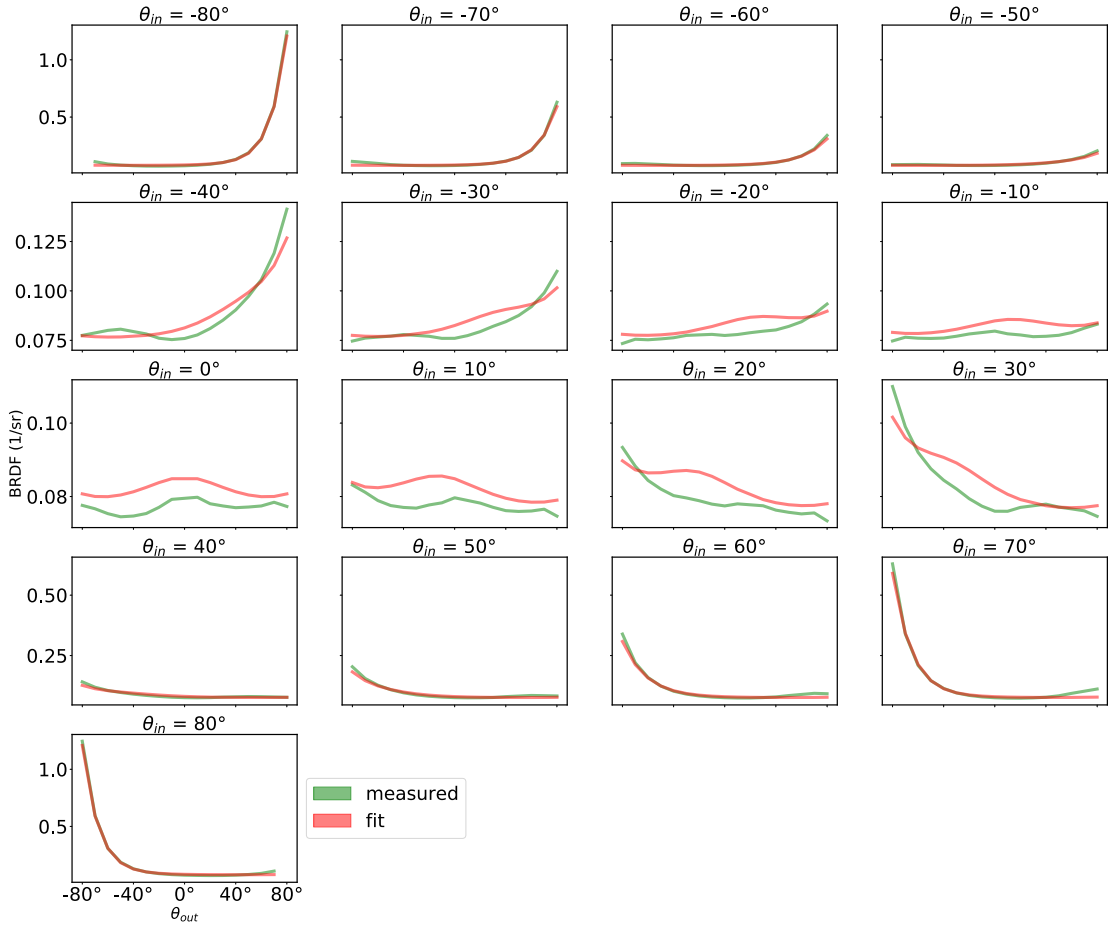


Our

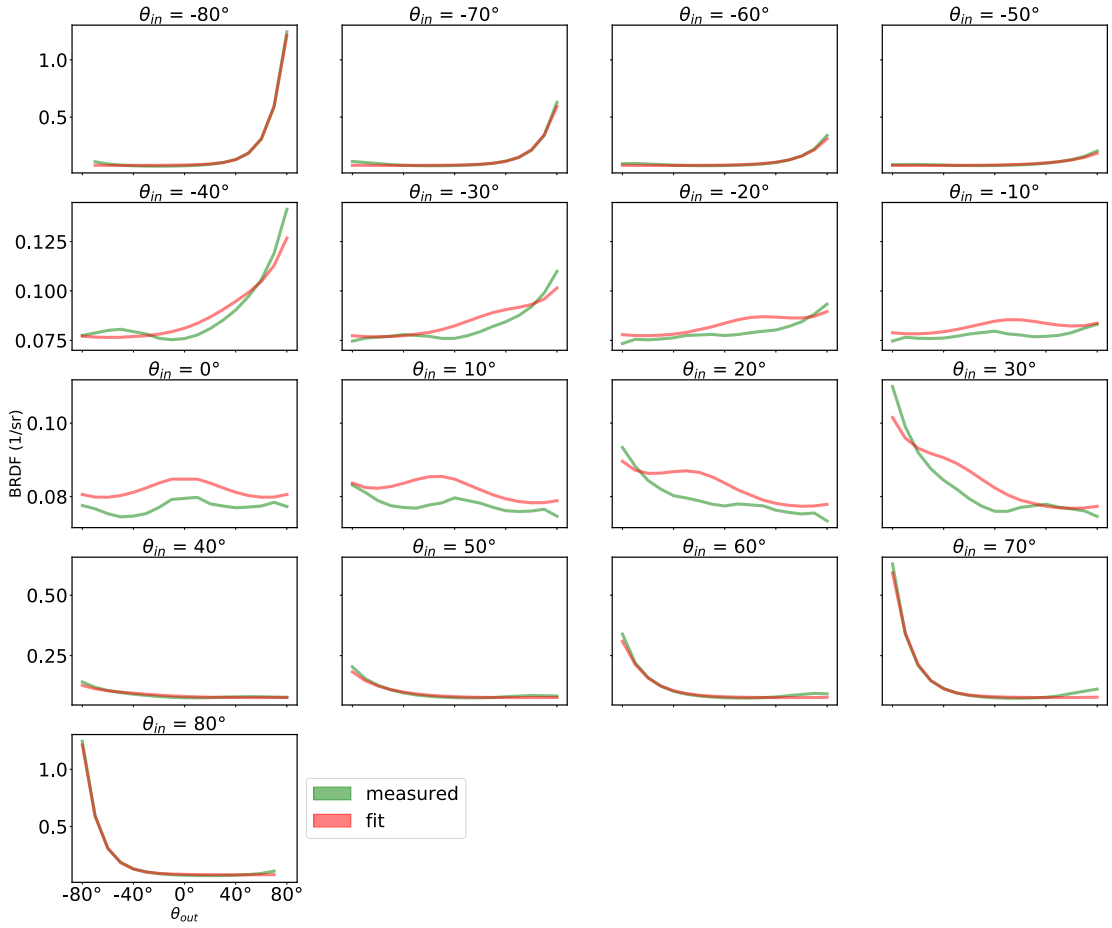


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



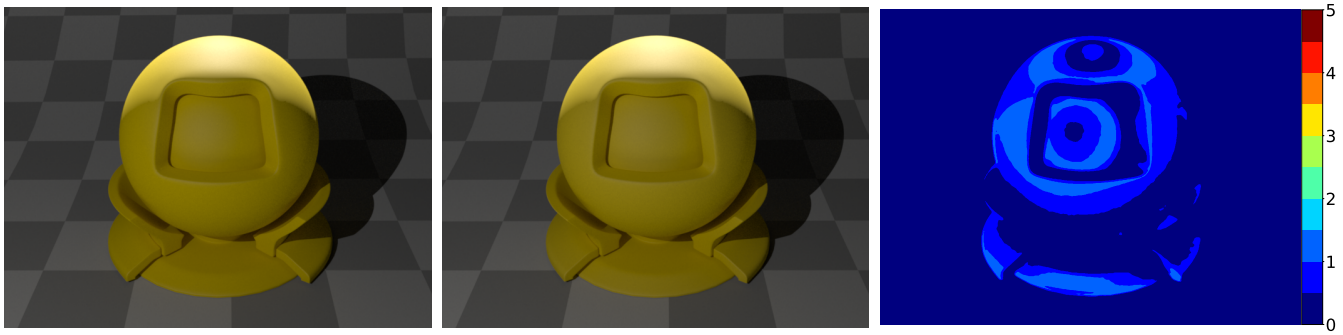
Our



ColorChecker - Patch 16

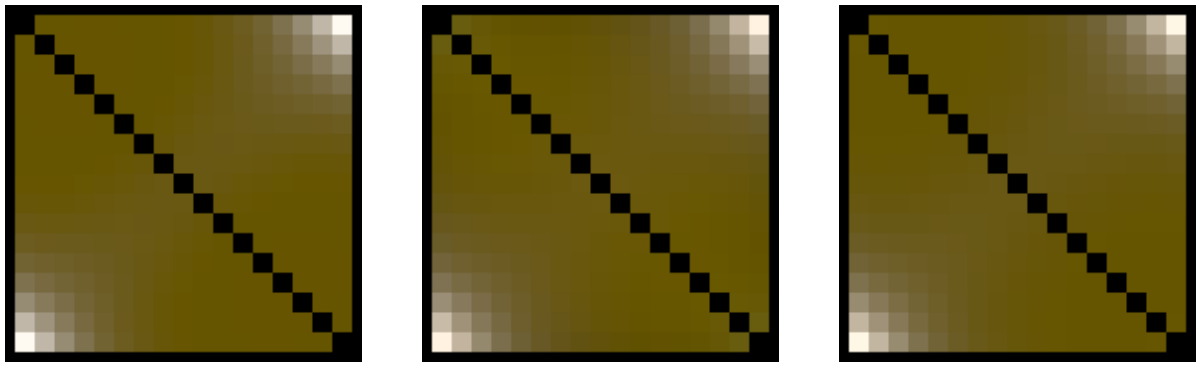
Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000



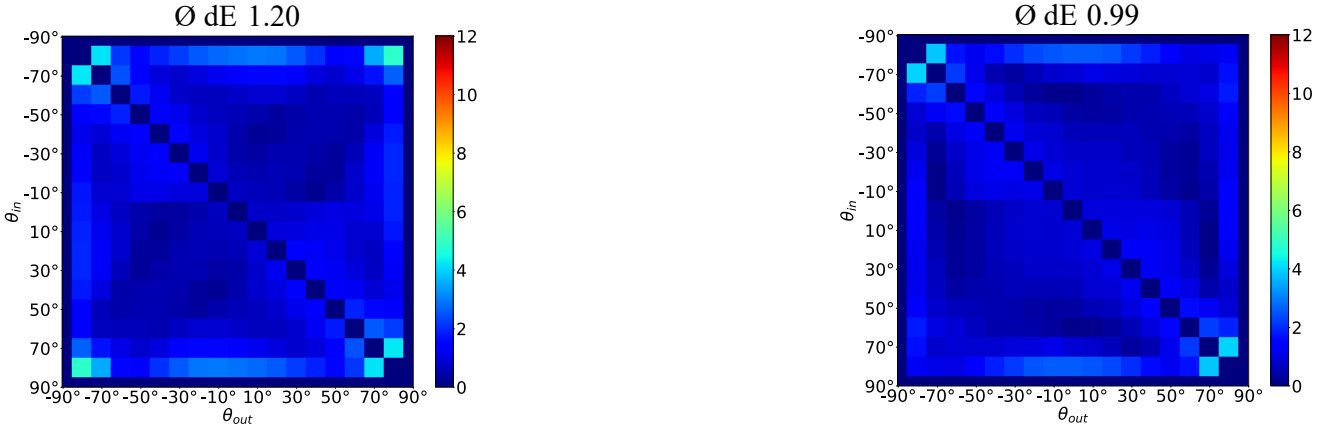
rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our



dE 2000

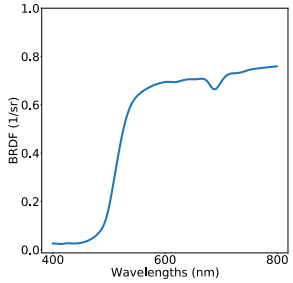
Ø dE 1.20 | Ø dE 0.99



Fitting result

Cook-Torrance GGX

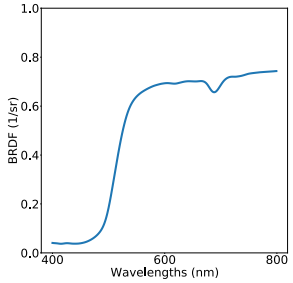
diffuse albedo



alpha = 0.4264
n_ior = 1.5422

Our

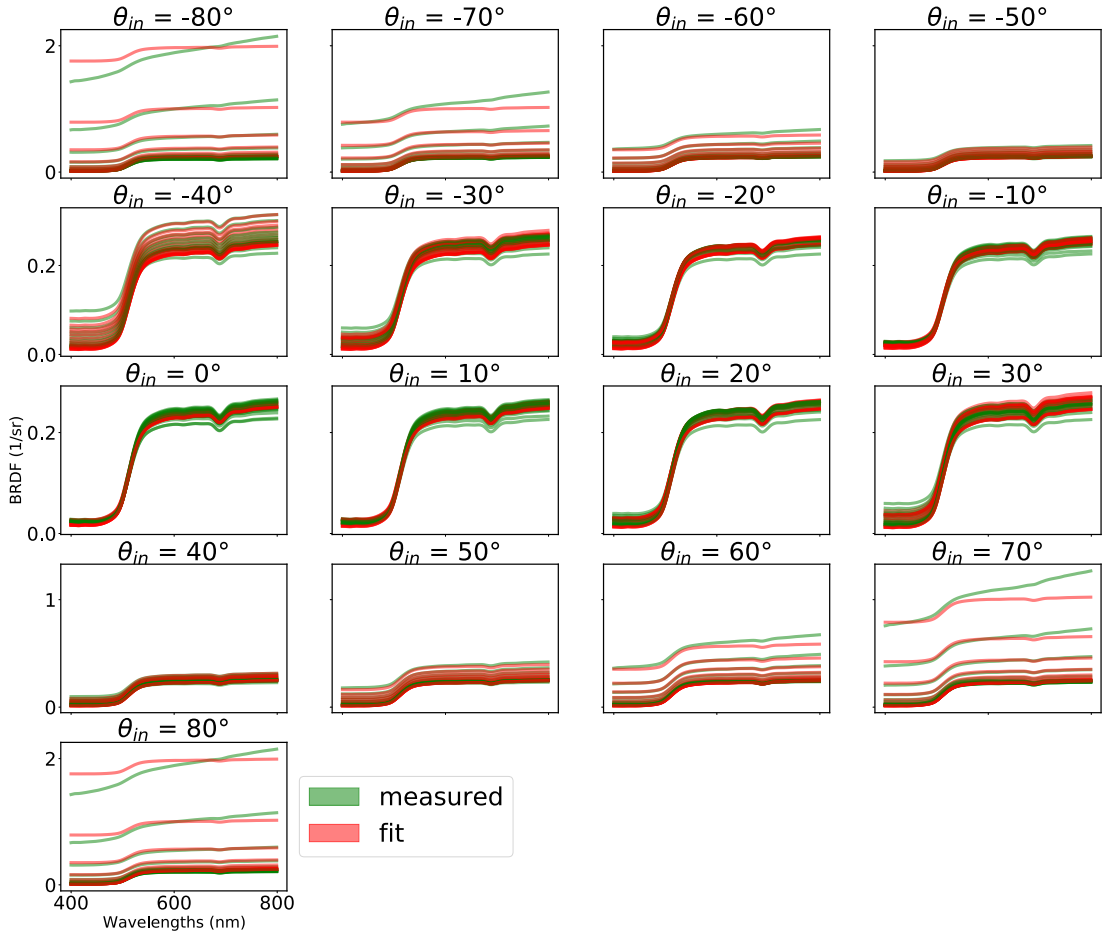
diffuse albedo



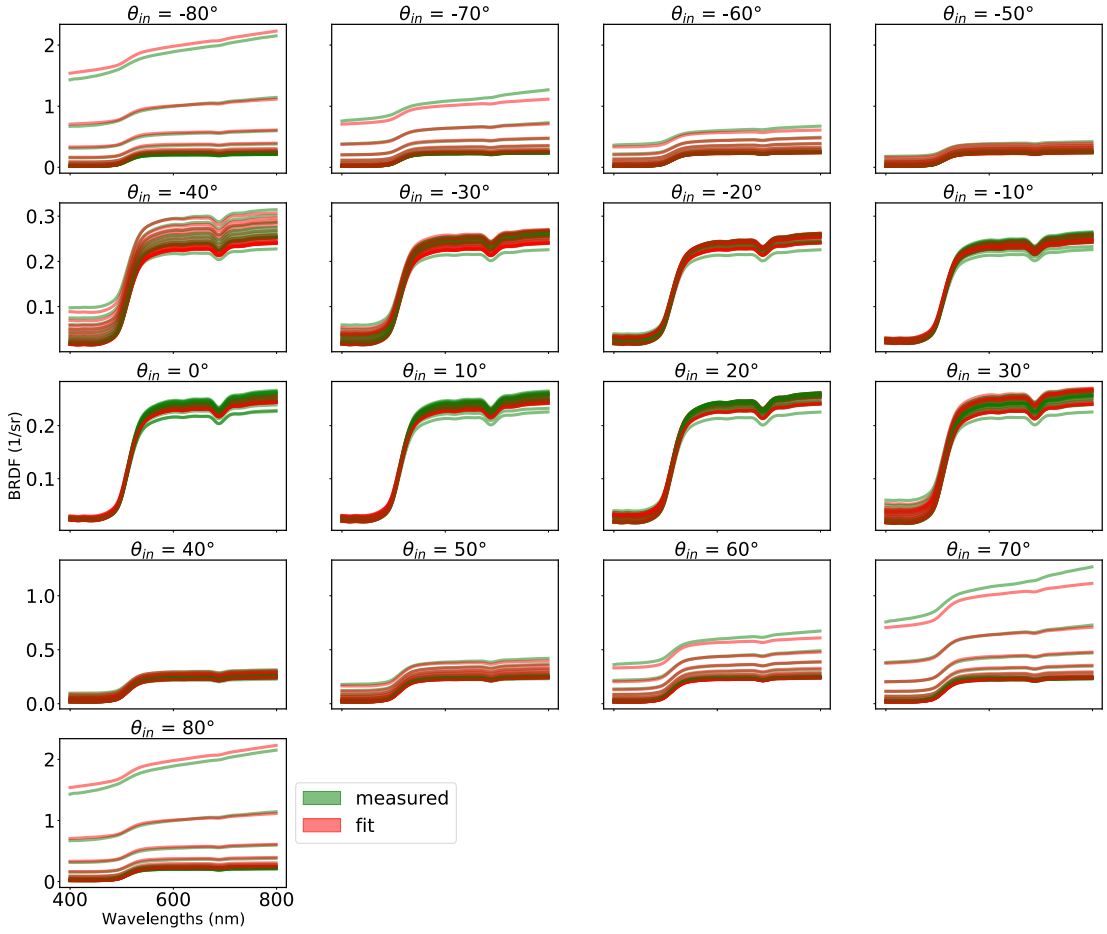
alpha = 0.4258
n_ior = 1.5441
height = 6.63E-04
width = 5.3707

Measured vs. fitted spectra

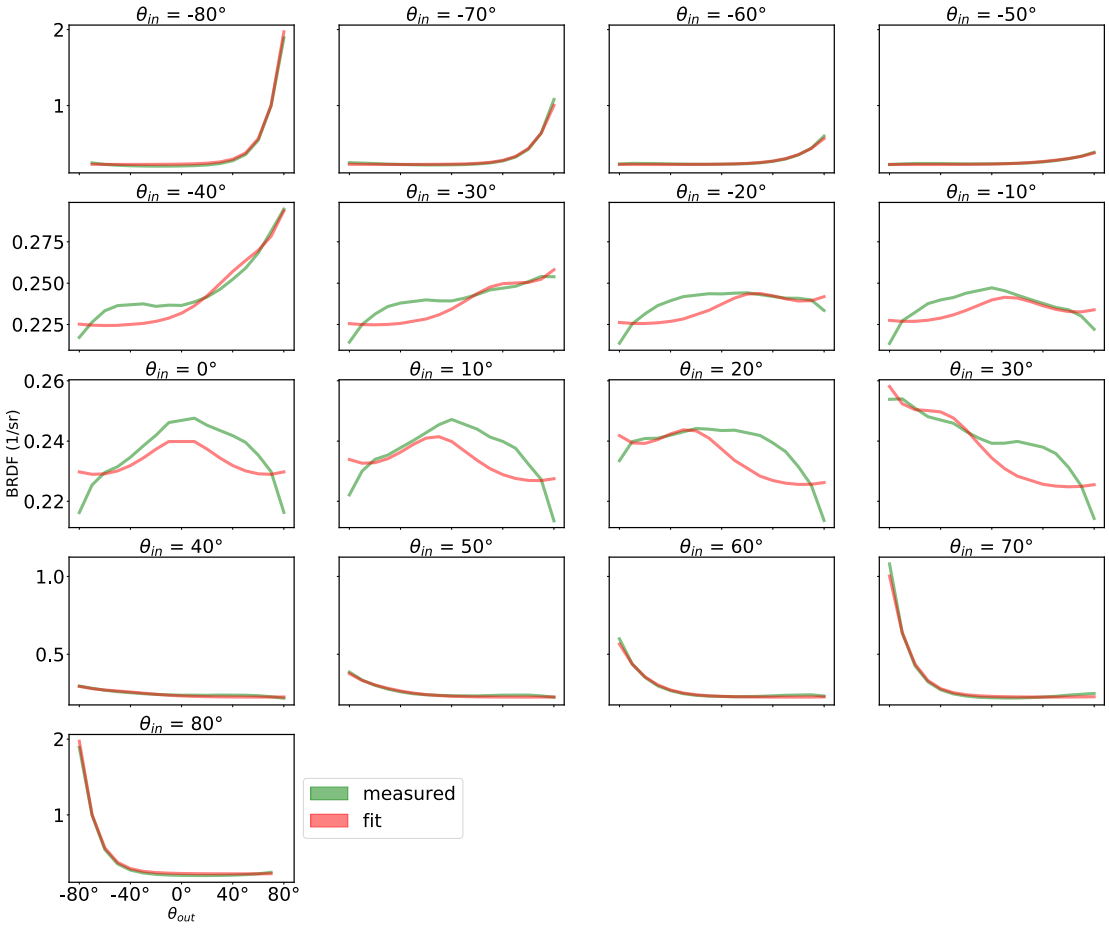
Cook-Torrance GGX

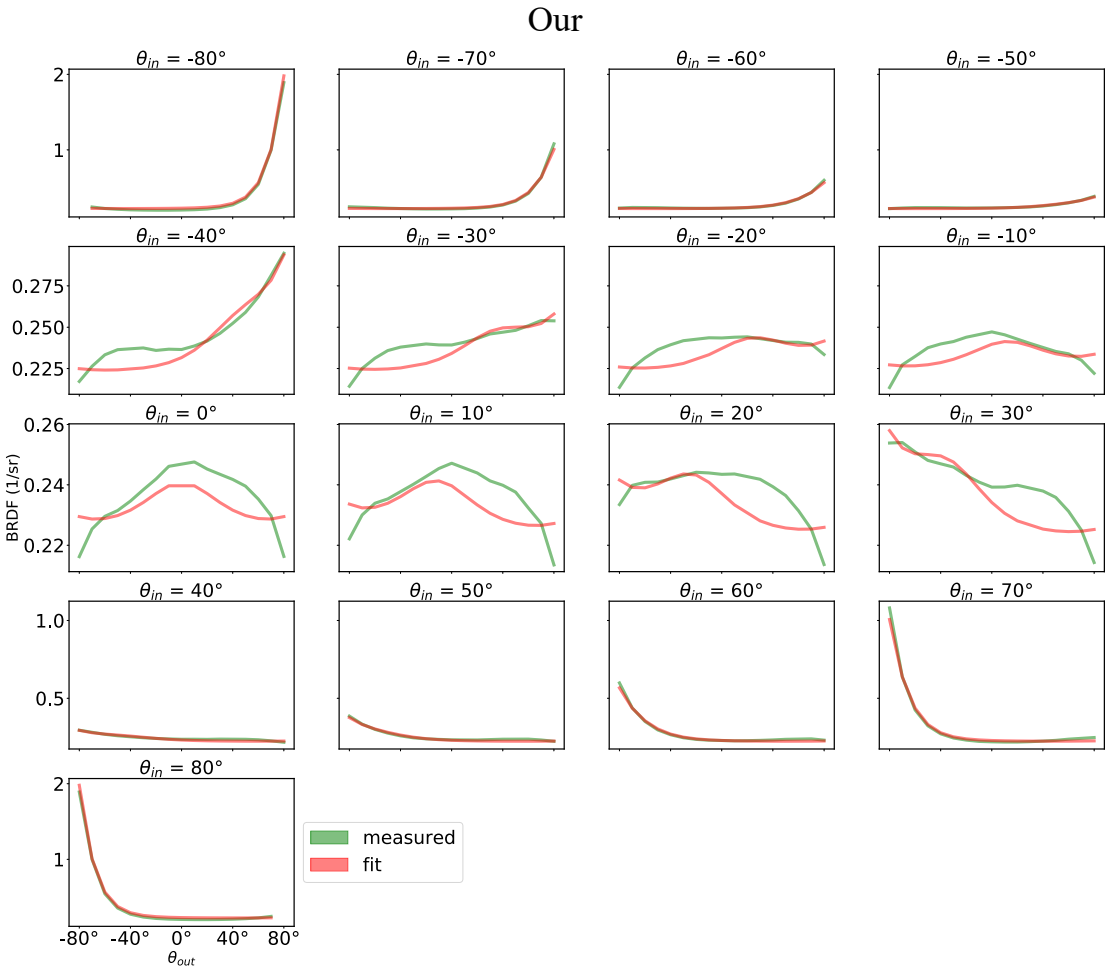


Our



Measured vs. fitted
scatter distribution at 600 nm

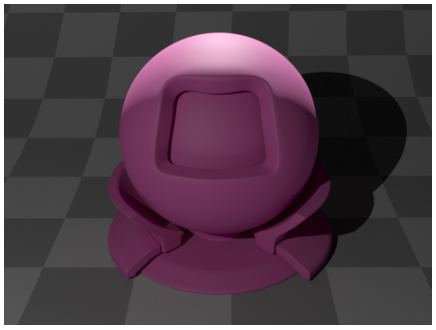




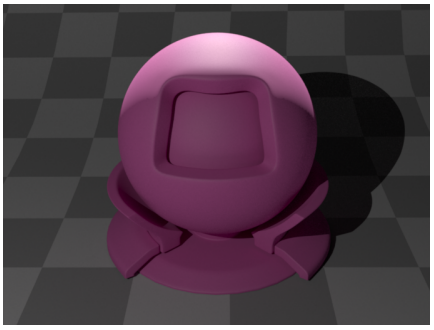
ColorChecker - Patch 17

Rendering (Computed with Mitsuba 2)

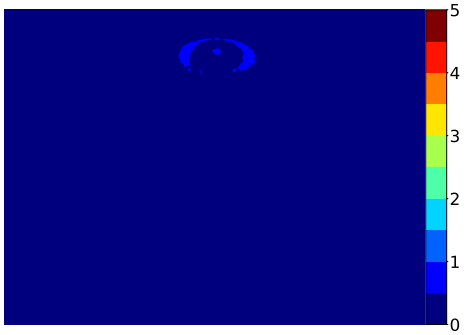
Cook-Torrance GGX



Our

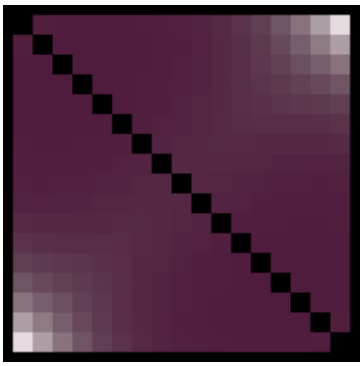


dE 2000

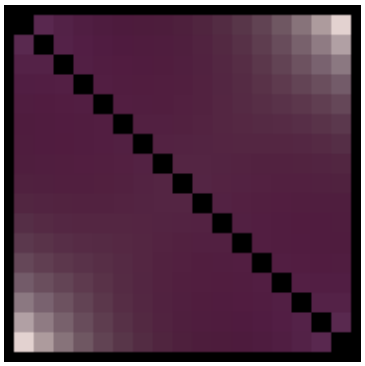


rgb image of in-plane BRDF

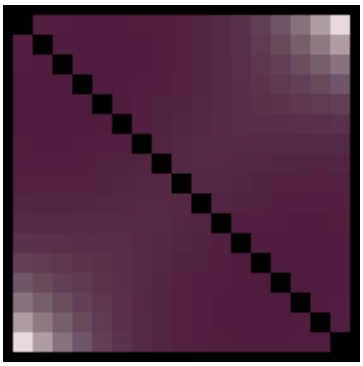
Cook-Torrance GGX



Measurement

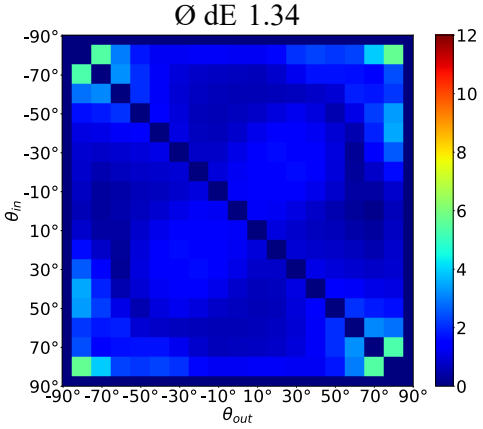


Our

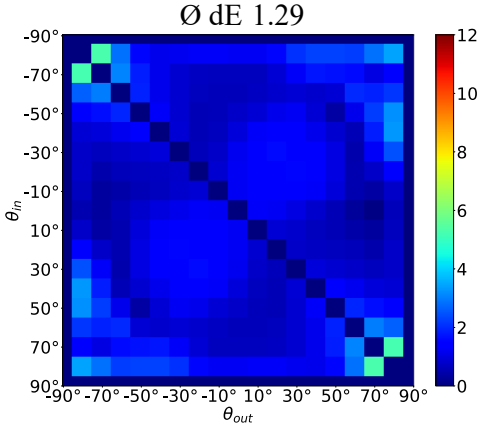


dE 2000

Ø dE 1.34



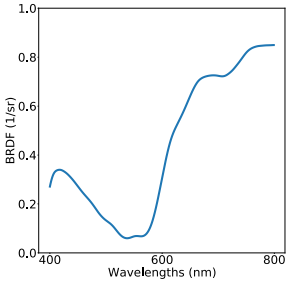
Ø dE 1.29



Fitting result

Cook-Torrance GGX

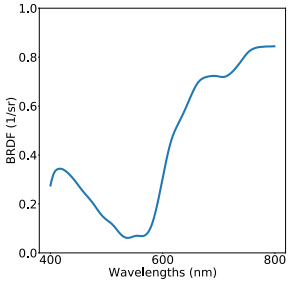
diffuse albedo



alpha = 0.4640
n_ior = 1.7095

Our

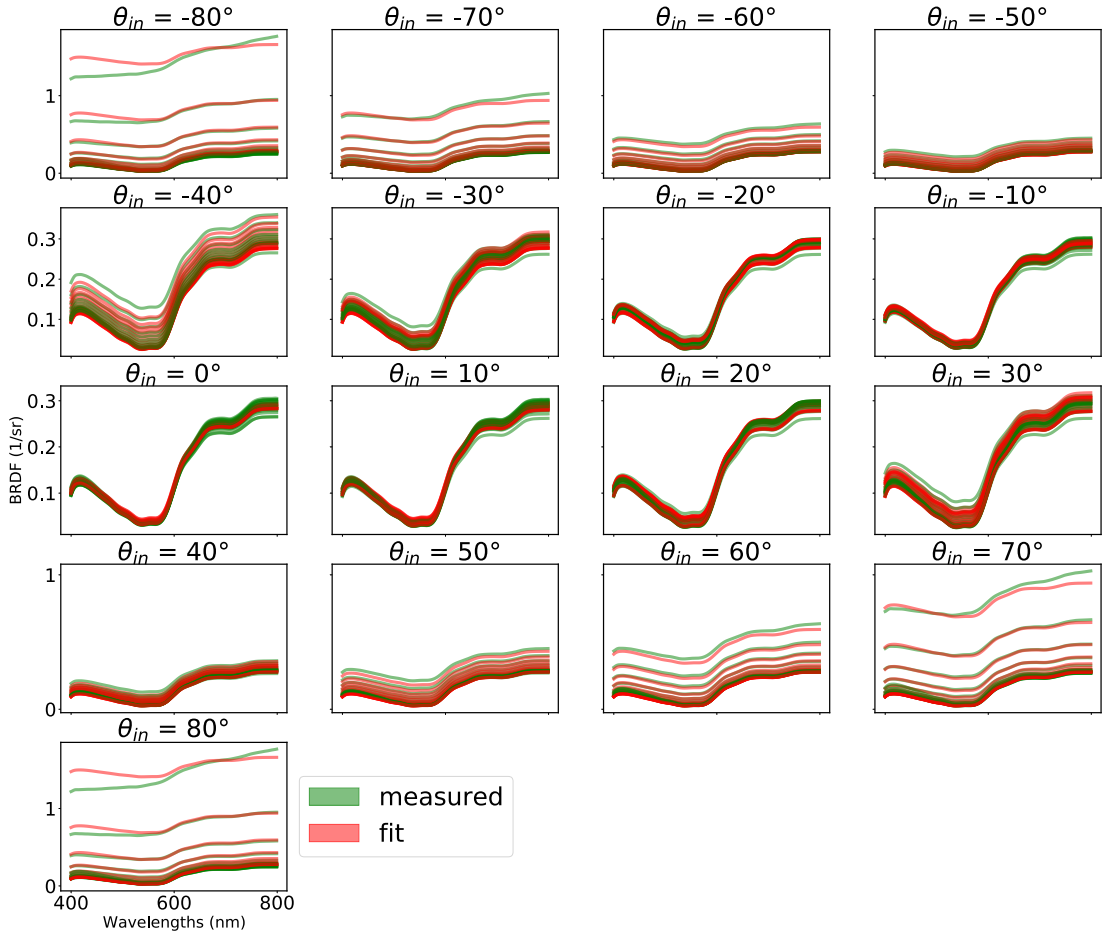
diffuse albedo



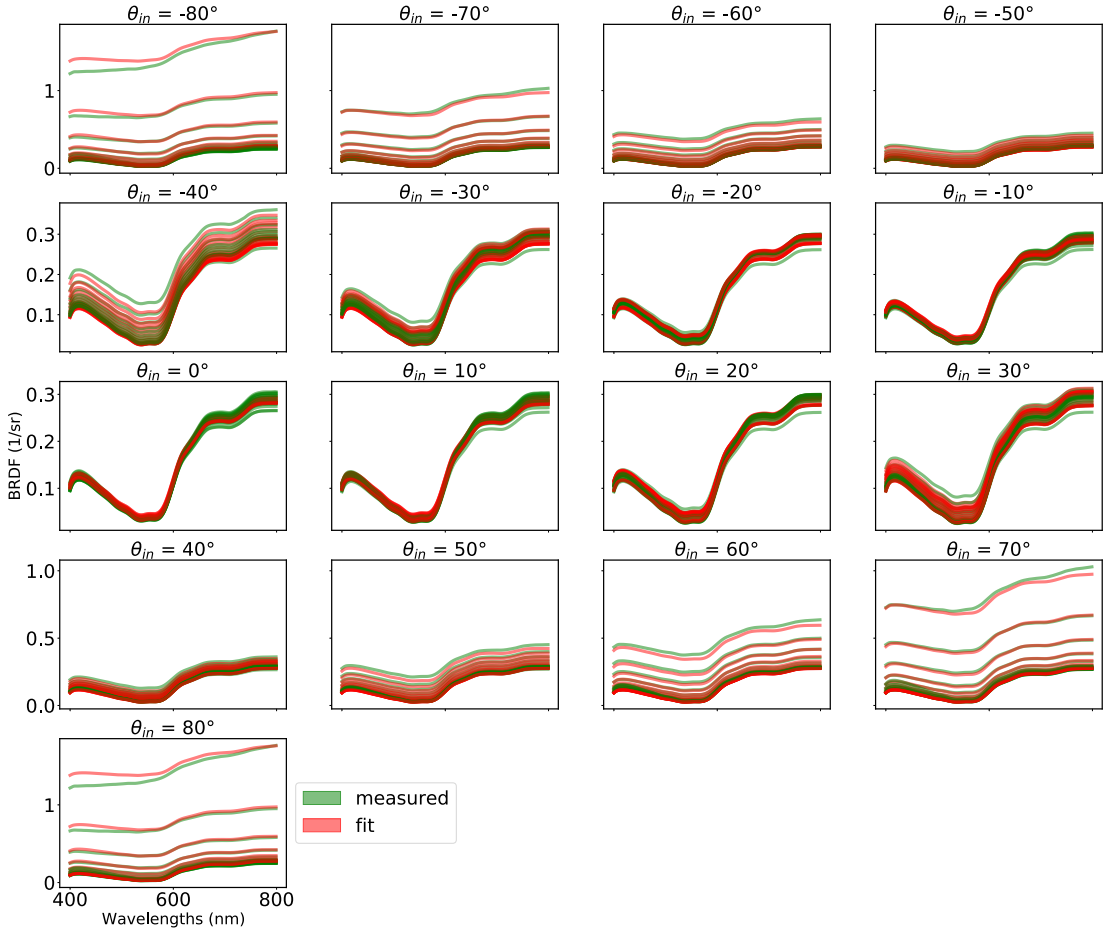
alpha = 0.4636
n_ior = 1.7085
height = 3.57E-04
width = 8.3306

Measured vs. fitted spectra

Cook-Torrance GGX

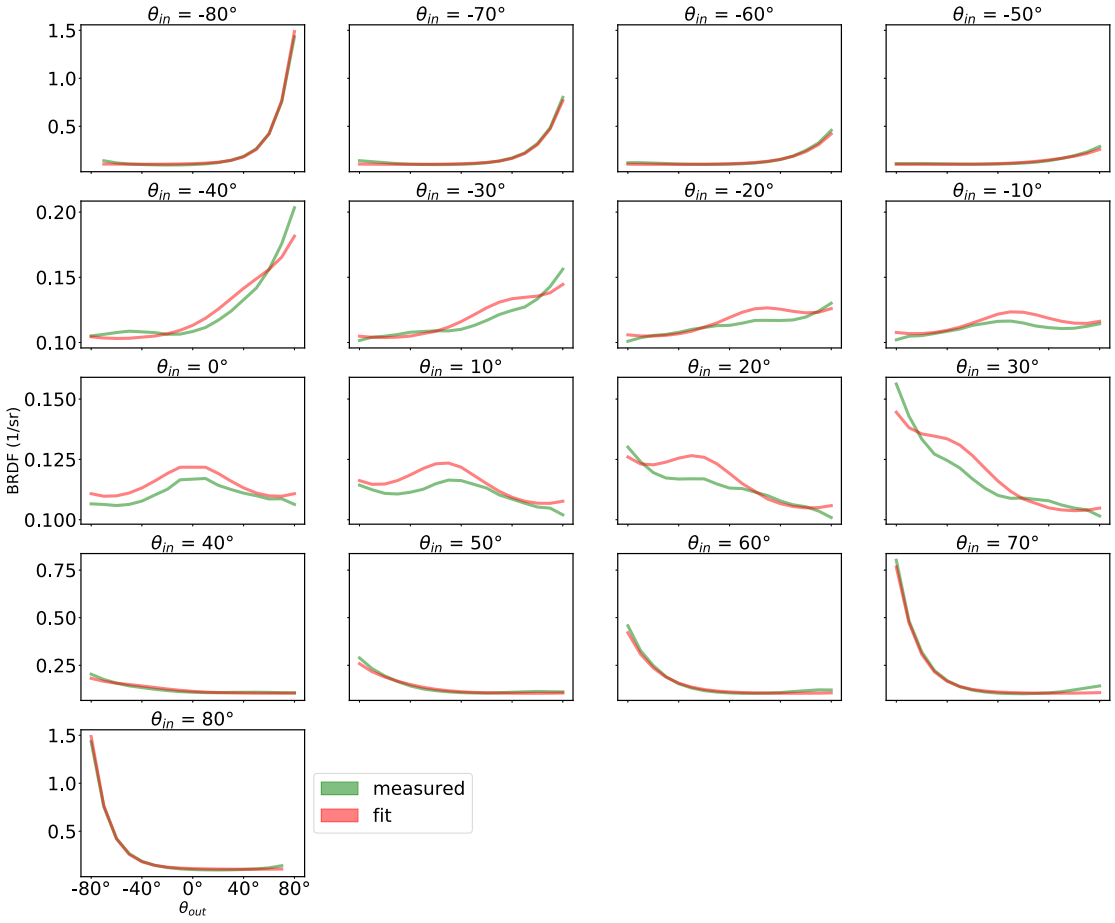


Our

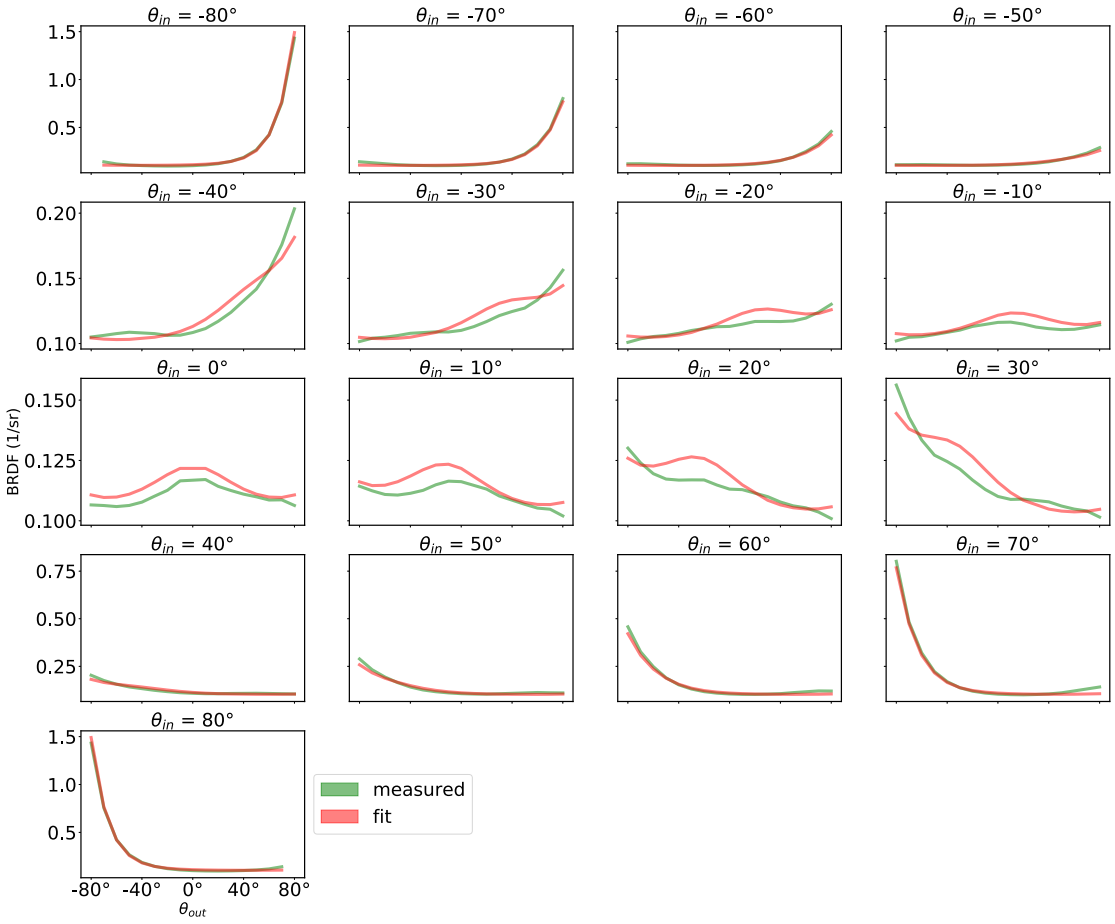


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

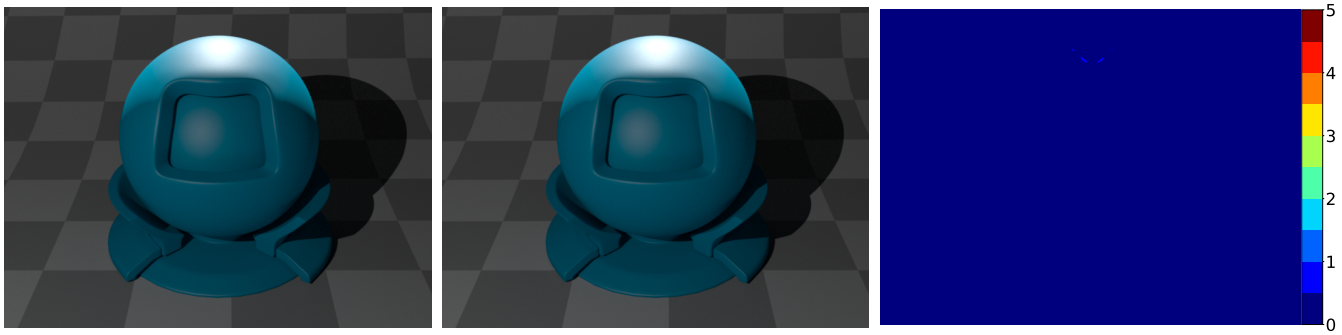


Our

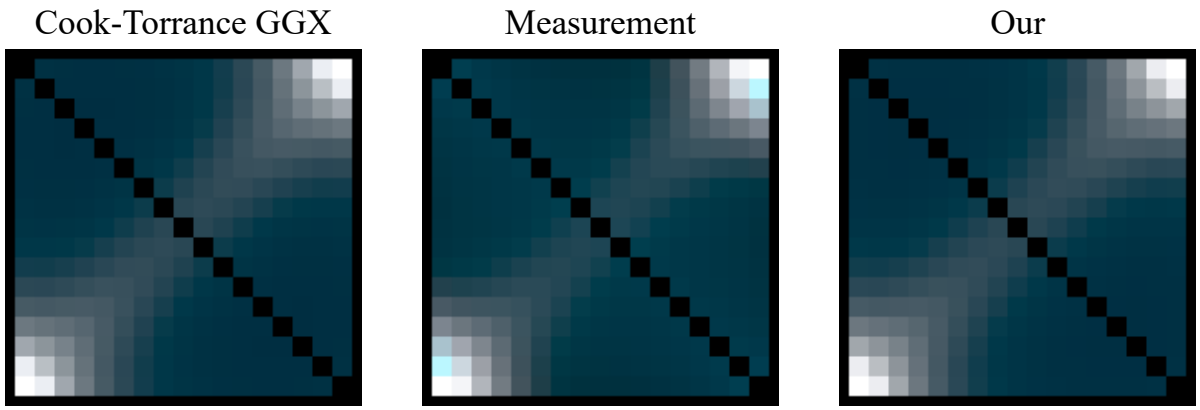


ColorChecker - Patch 18

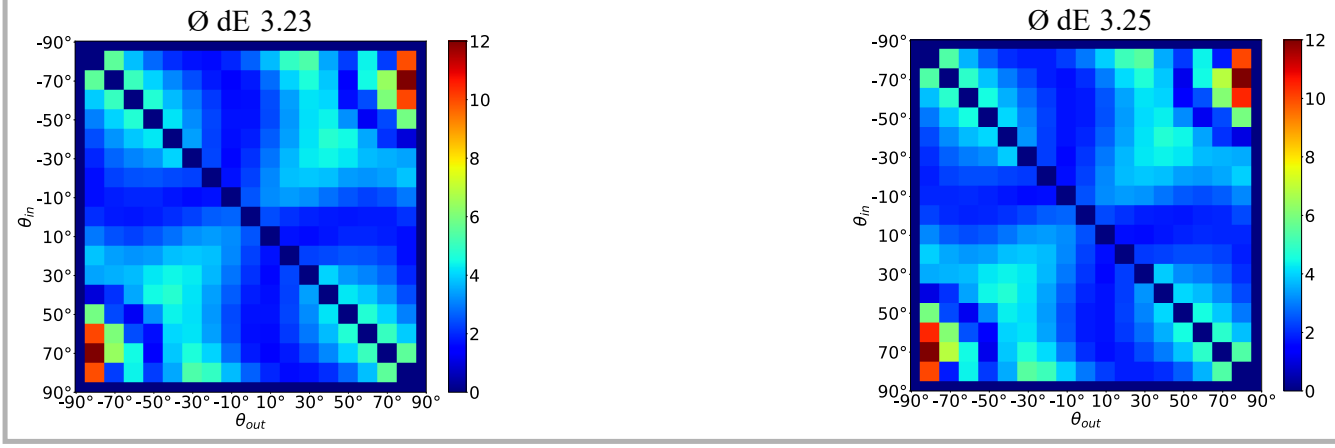
Rendering
(Computed with Mitsuba 2)



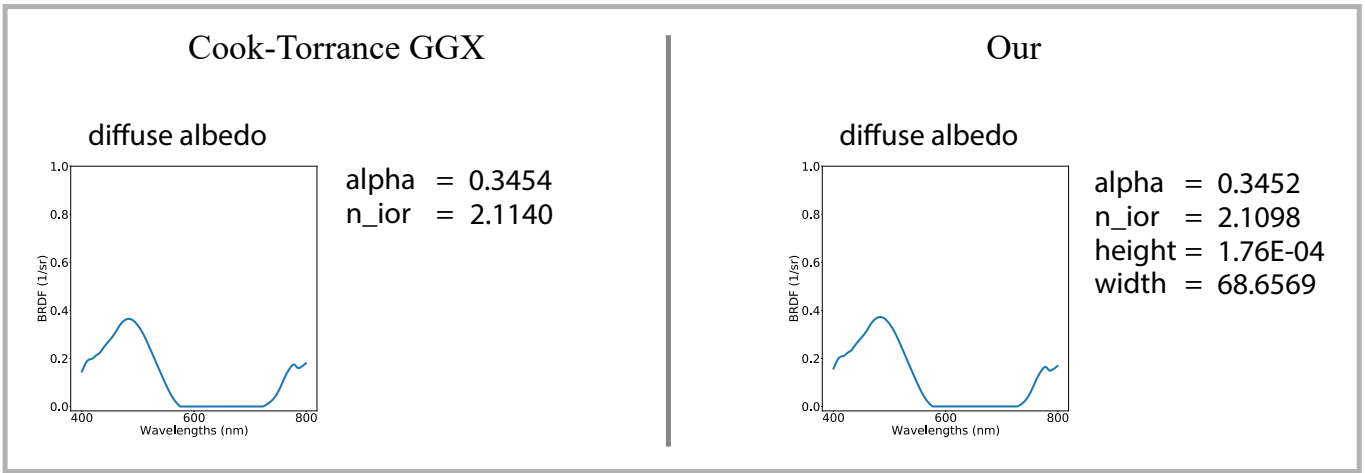
rgb image of
in-plane BRDF



dE 2000

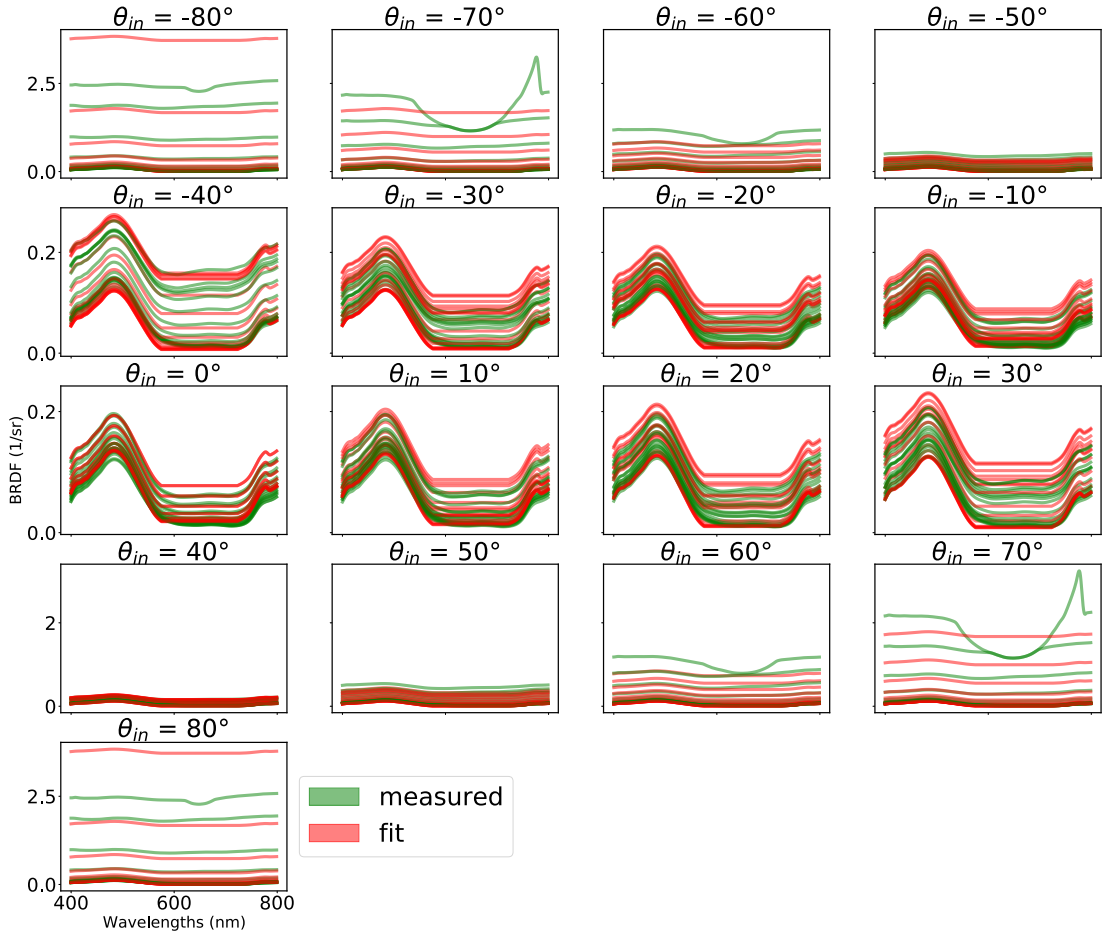


Fitting result

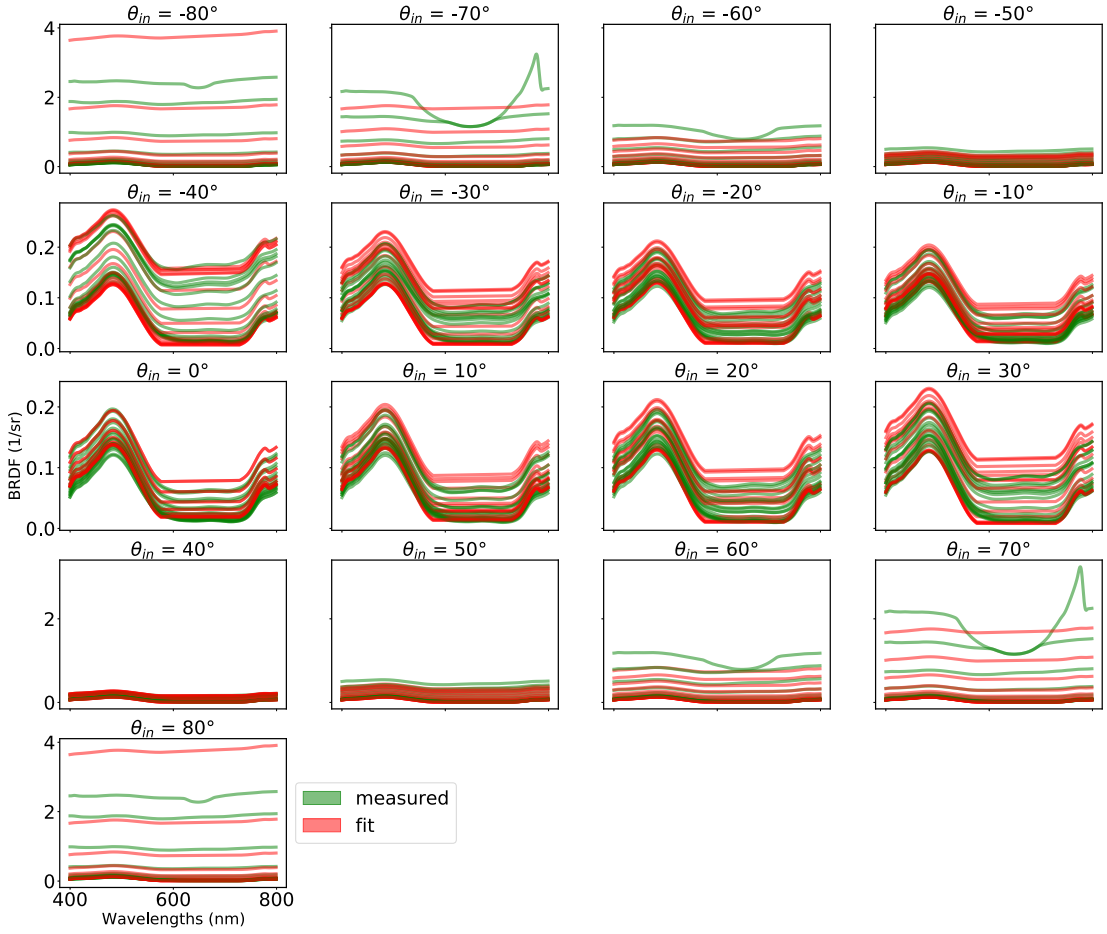


Measured vs. fitted spectra

Cook-Torrance GGX

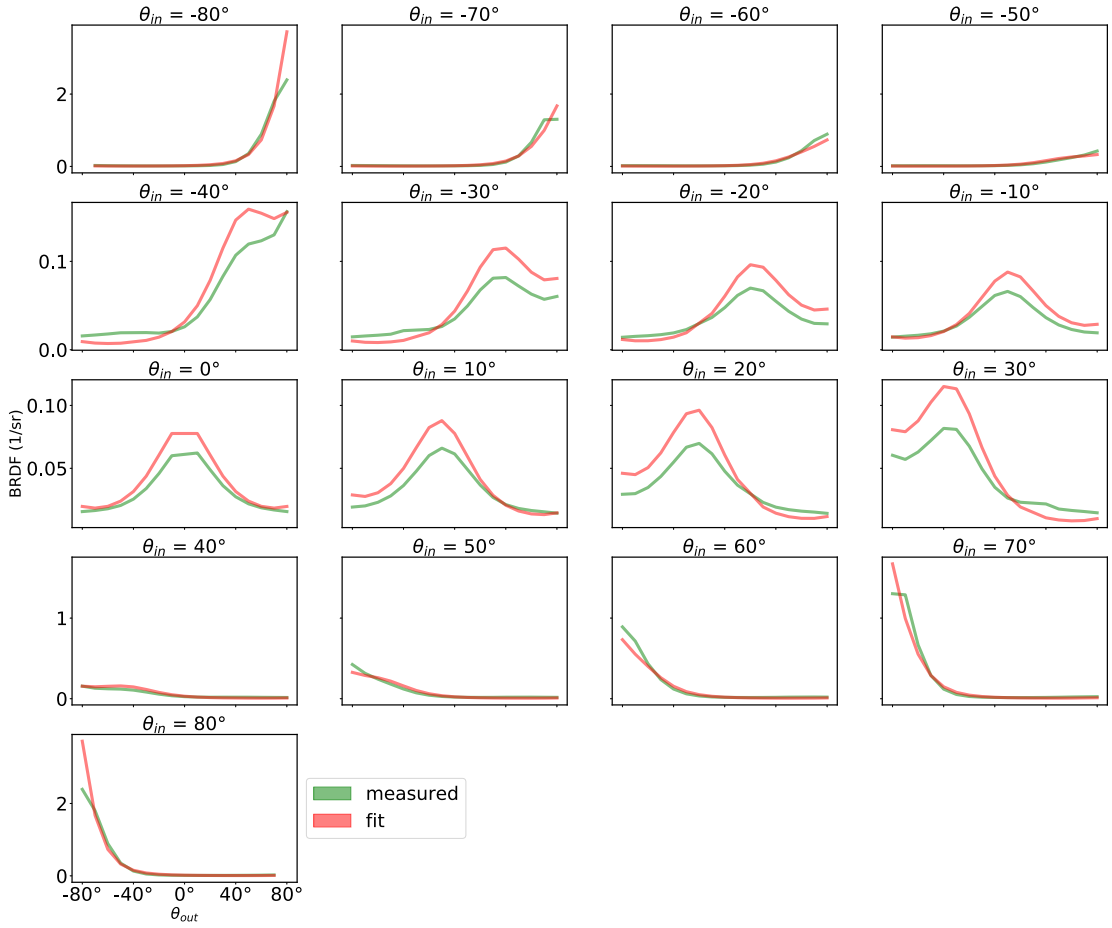


Our

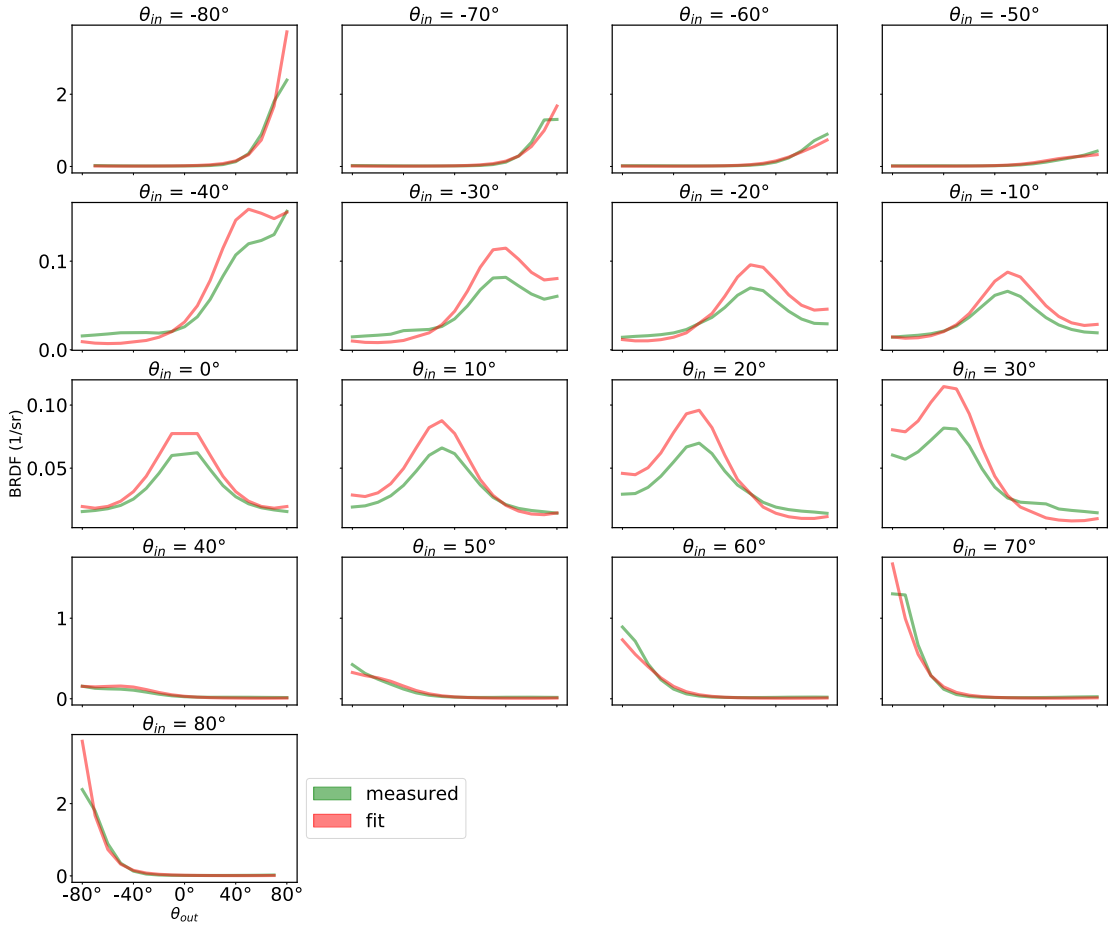


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



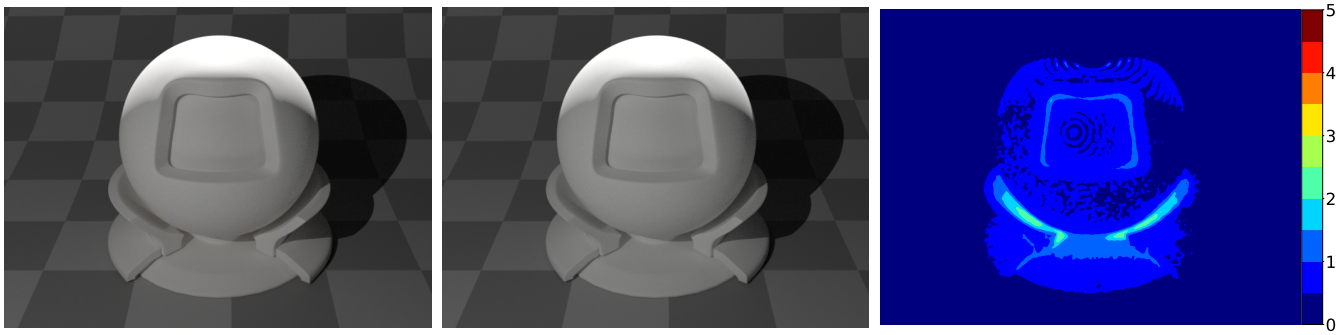
Our



ColorChecker - Patch 19

Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000

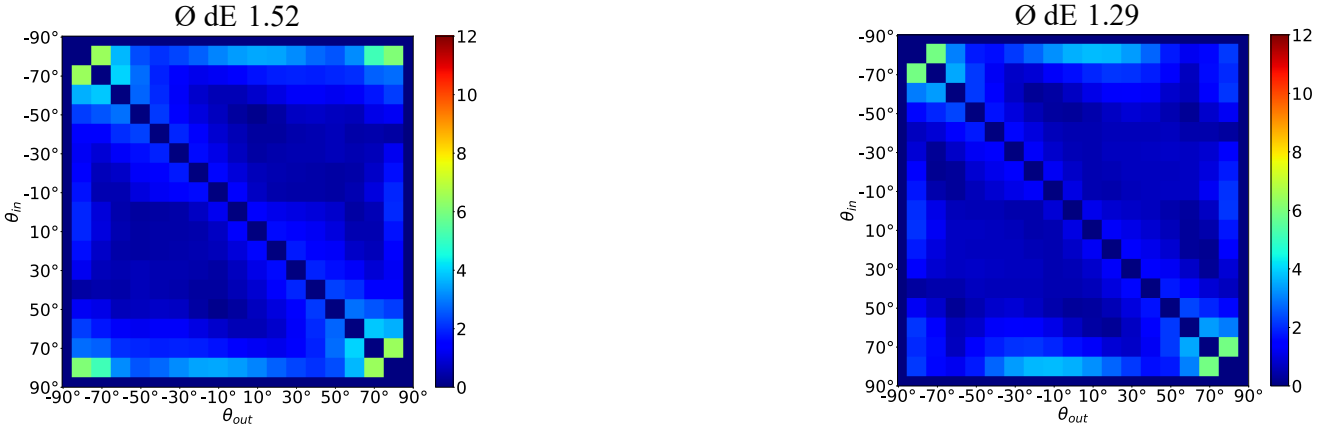


rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our

dE 2000

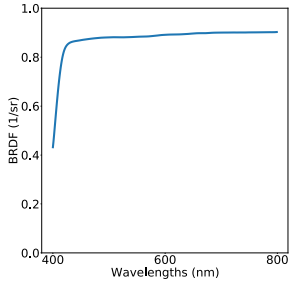
Ø dE 1.52 | Ø dE 1.29



Fitting result

Cook-Torrance GGX

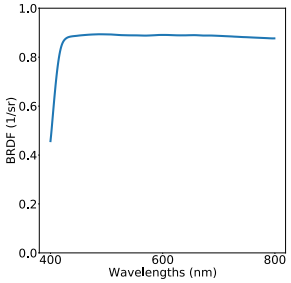
diffuse albedo



alpha = 0.4241
n_ior = 1.6163

Our

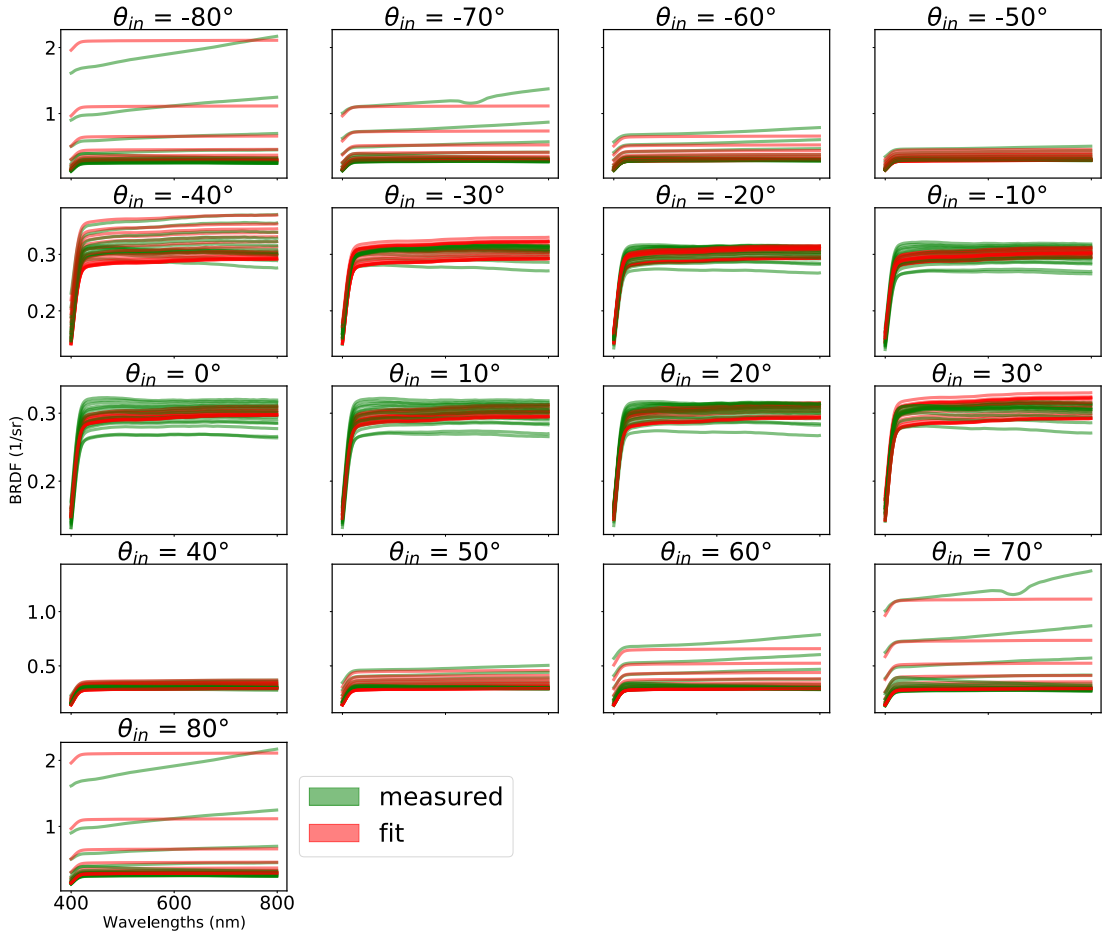
diffuse albedo



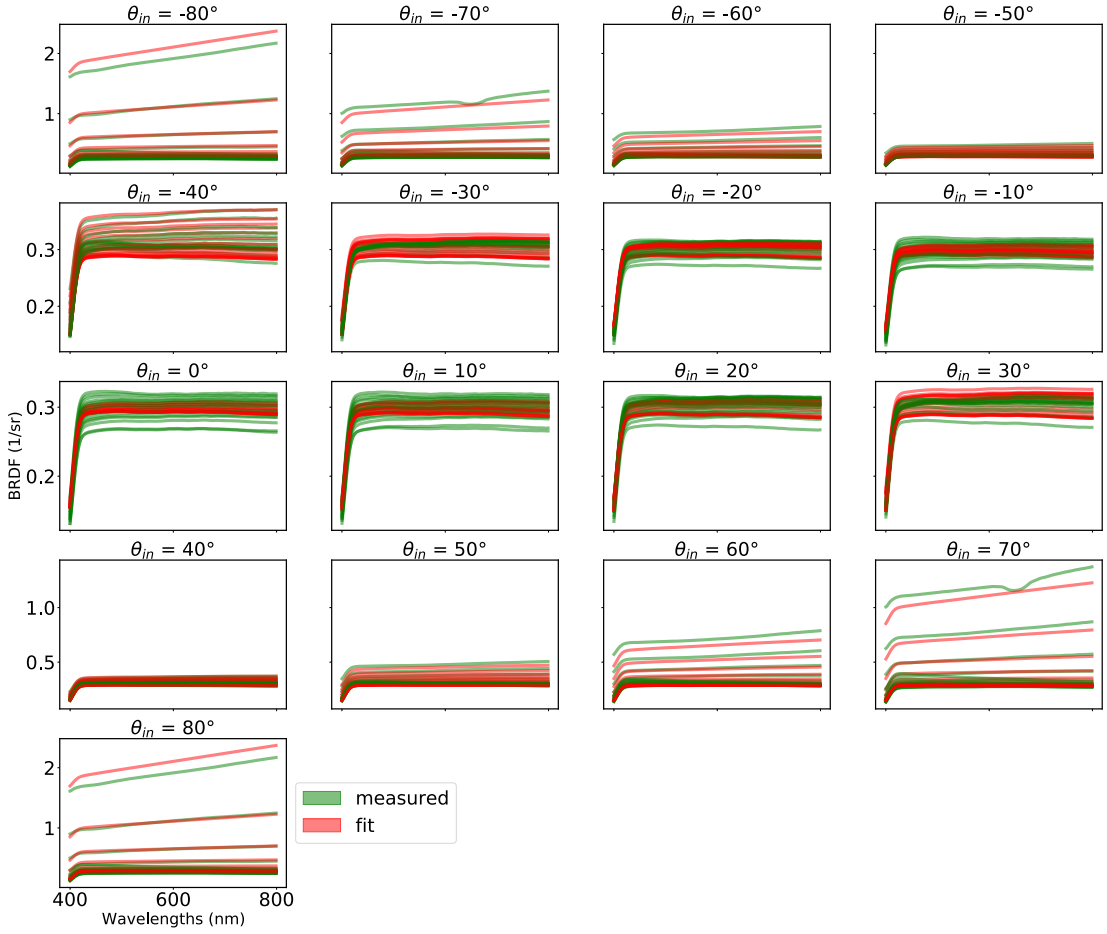
alpha = 0.4242
n_ior = 1.6193
height = 7.40E-04
width = 69.8870

Measured vs. fitted spectra

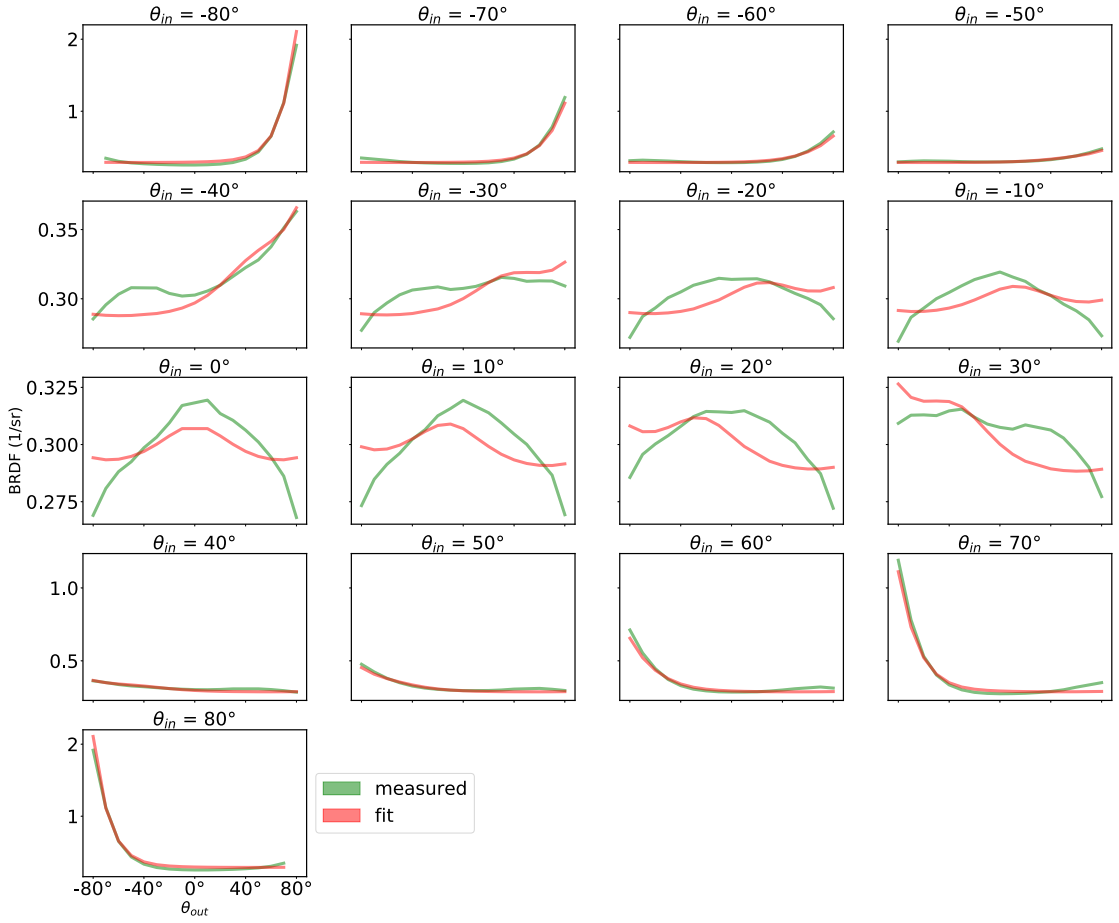
Cook-Torrance GGX

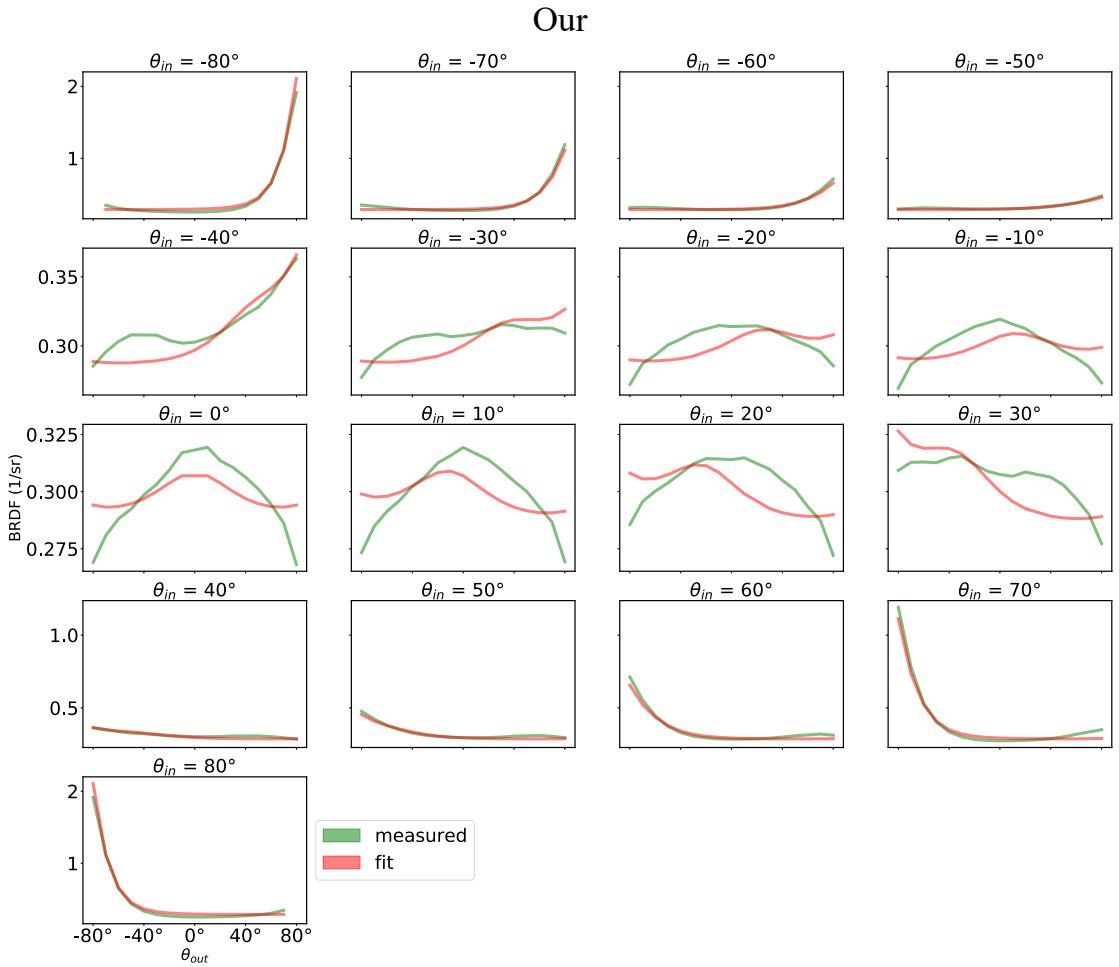


Our



Measured vs. fitted
scatter distribution at 600 nm

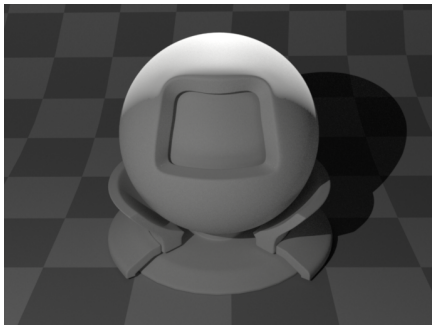




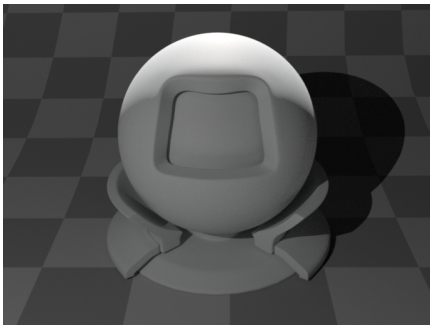
ColorChecker - Patch 20

Rendering (Computed with Mitsuba 2)

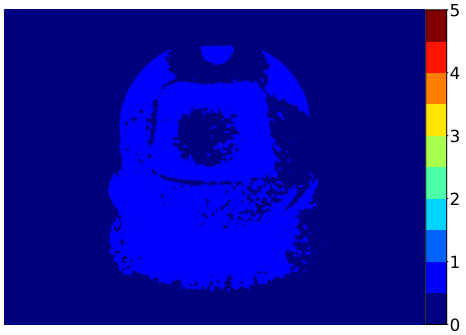
Cook-Torrance GGX



Our

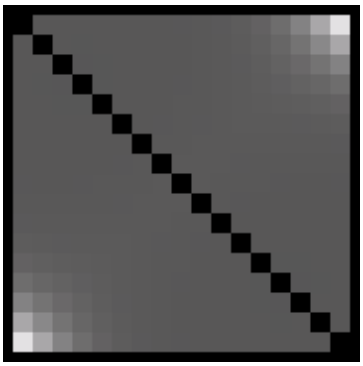


dE 2000



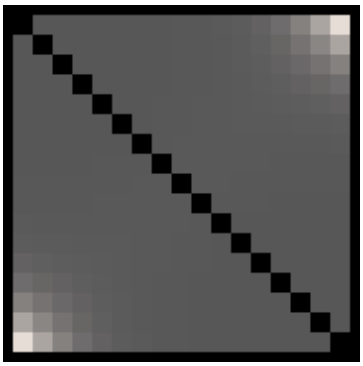
rgb image of in-plane BRDF

Cook-Torrance GGX



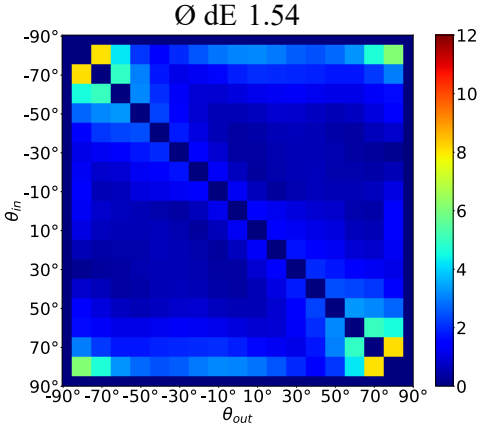
Measurement

Our

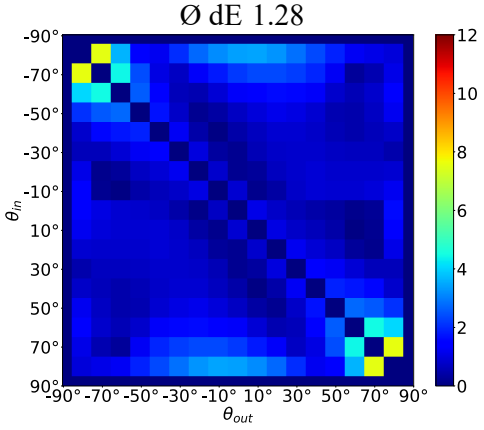


dE 2000

Ø dE 1.54



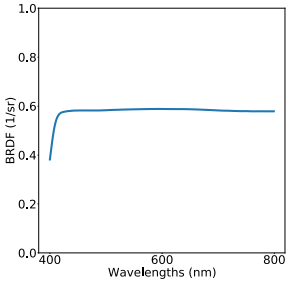
Ø dE 1.28



Fitting result

Cook-Torrance GGX

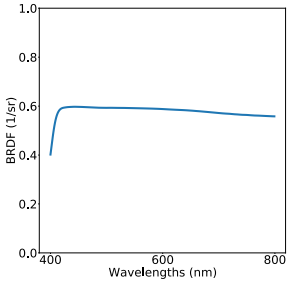
diffuse albedo



alpha = 0.4576
n_ior = 1.4468

Our

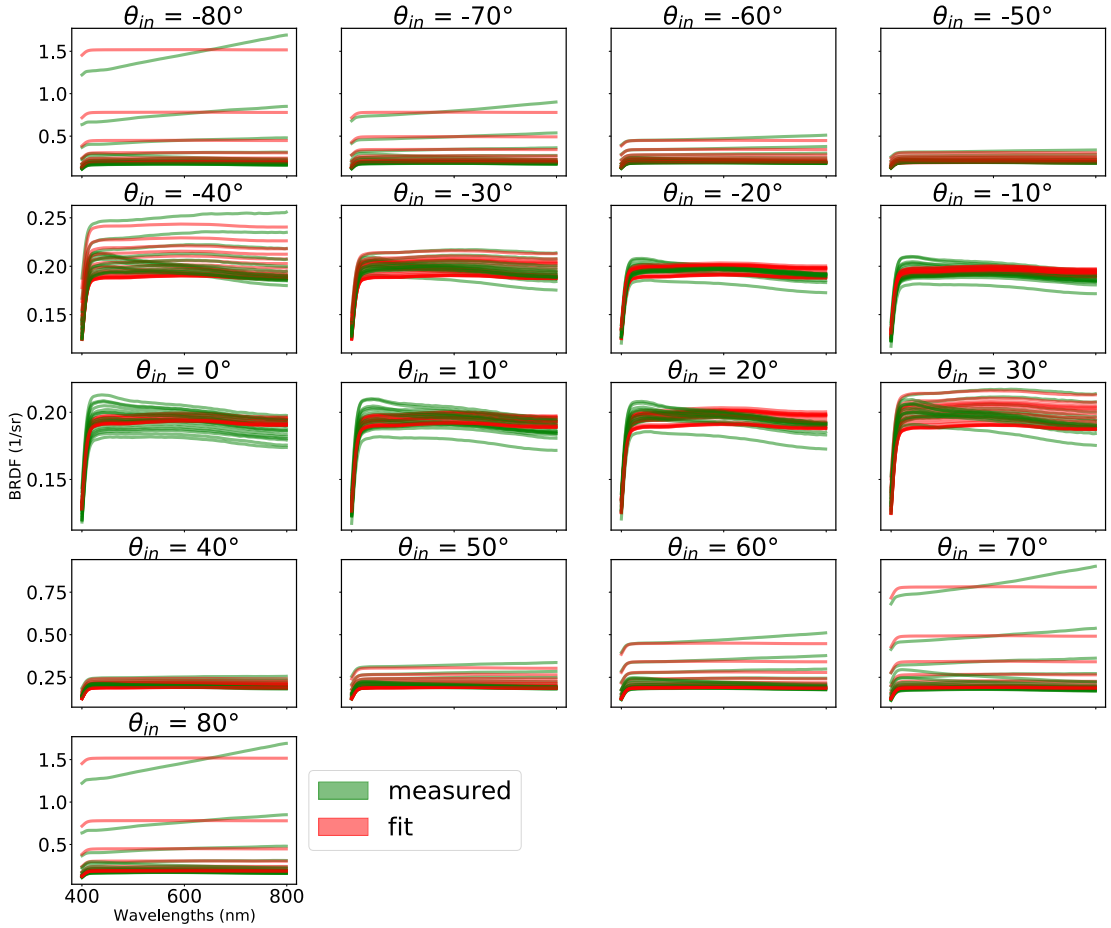
diffuse albedo



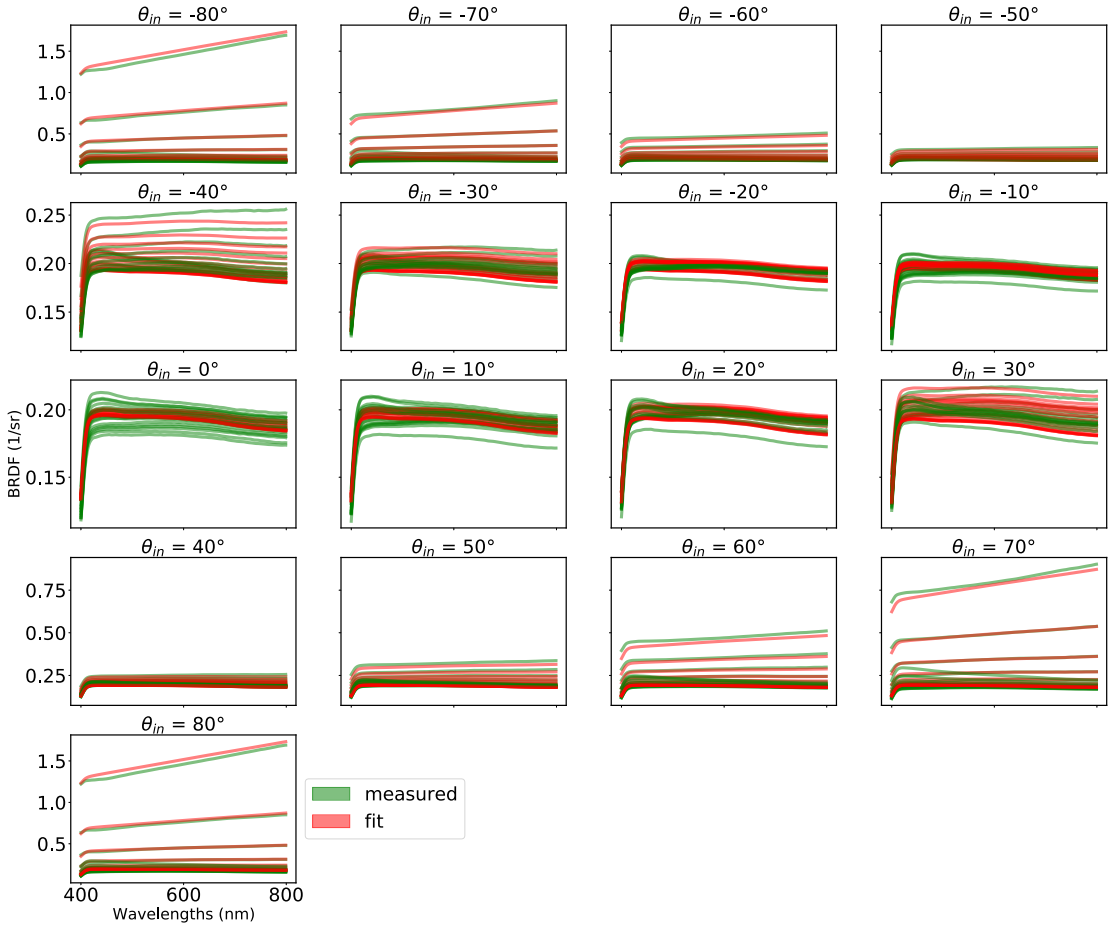
alpha = 0.4578
n_ior = 1.4494
height = 8.45E-04
width = 1.7525

Measured vs. fitted spectra

Cook-Torrance GGX

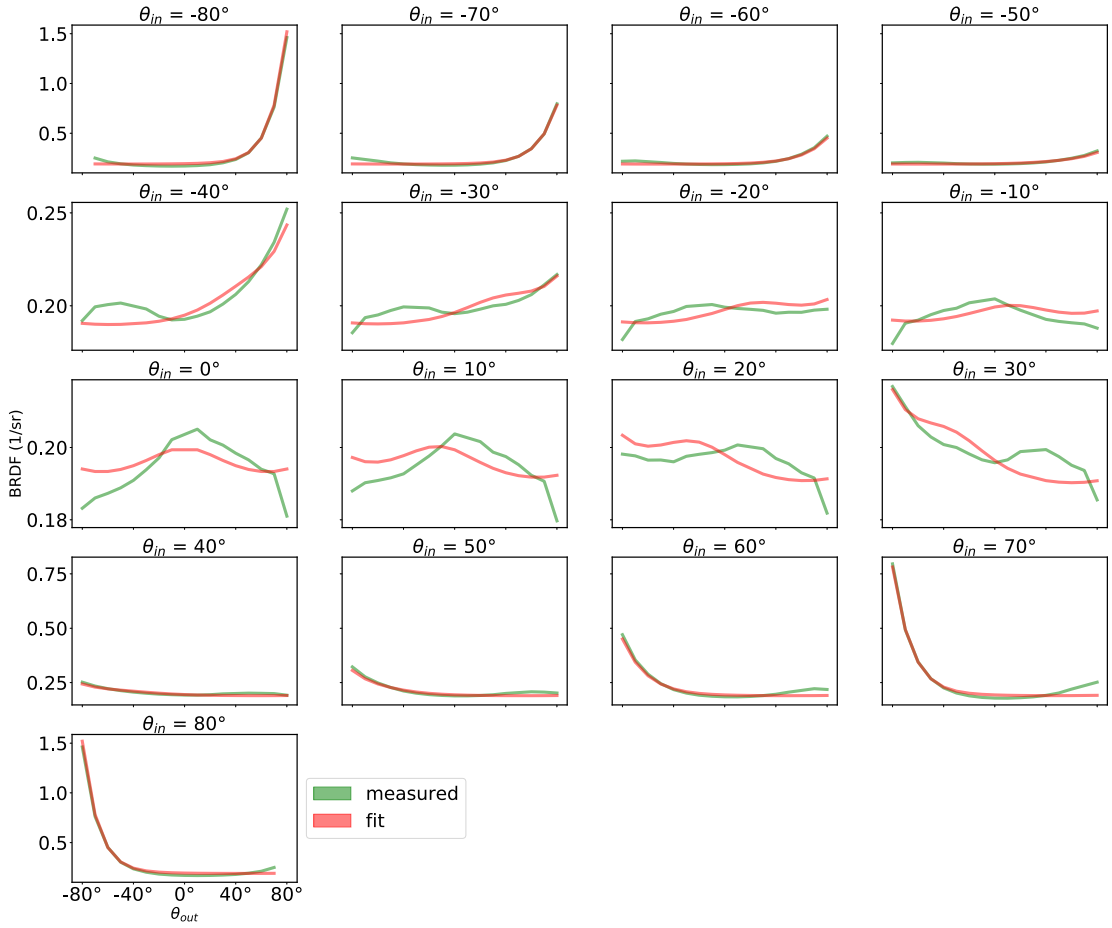


Our

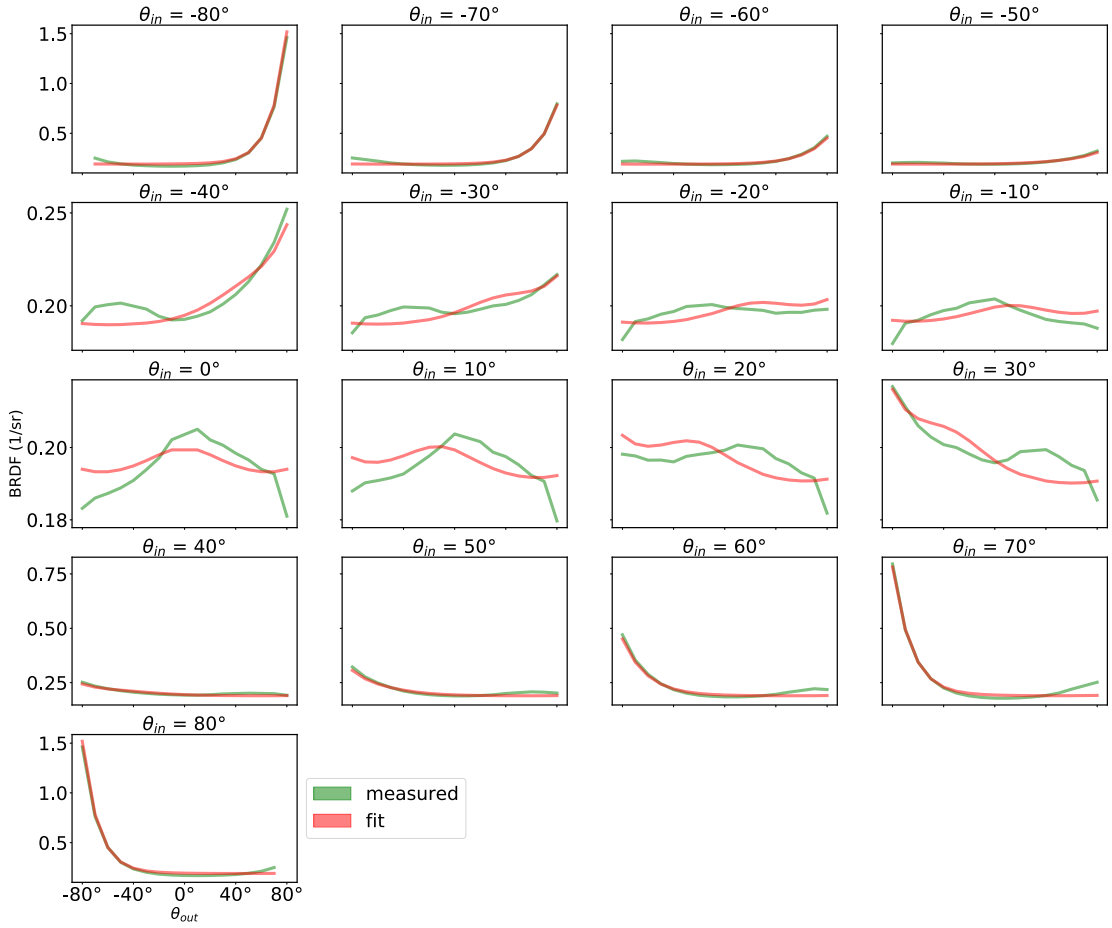


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

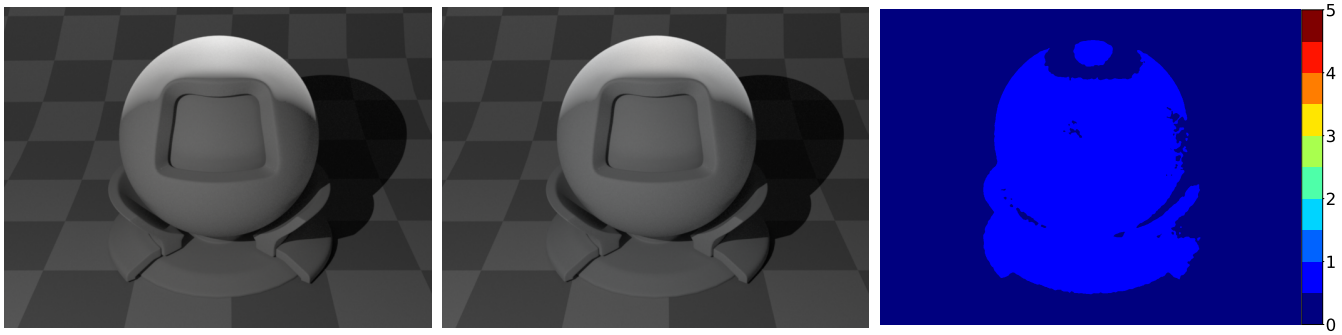


Our

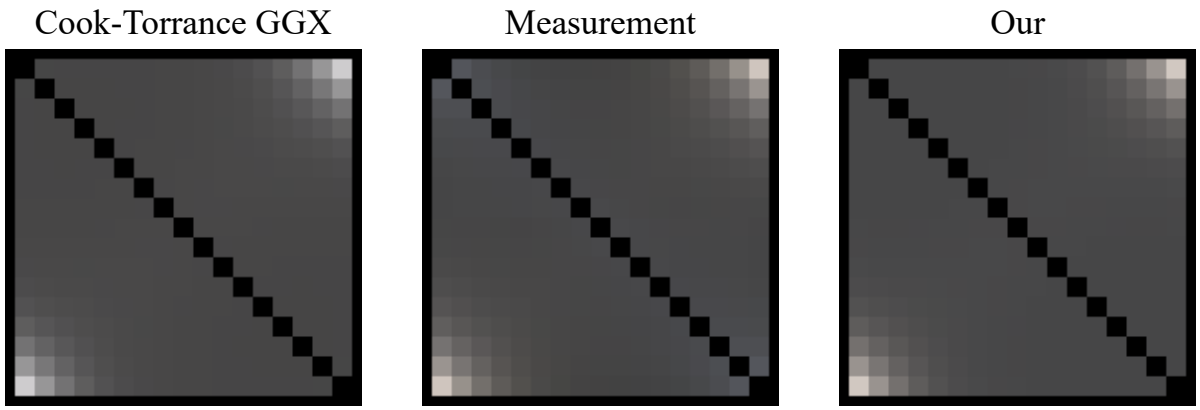


ColorChecker - Patch 21

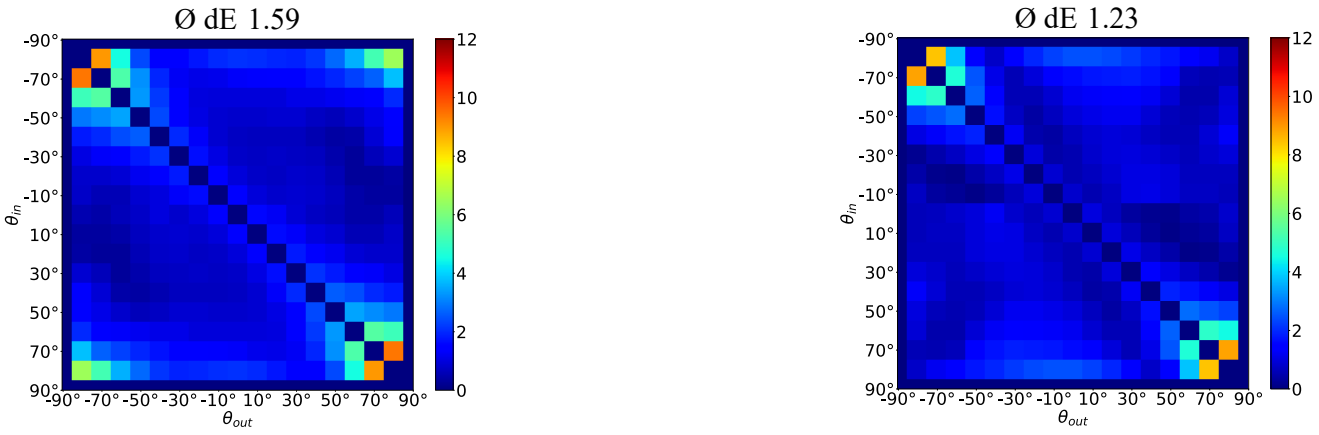
Rendering (Computed with Mitsuba 2)



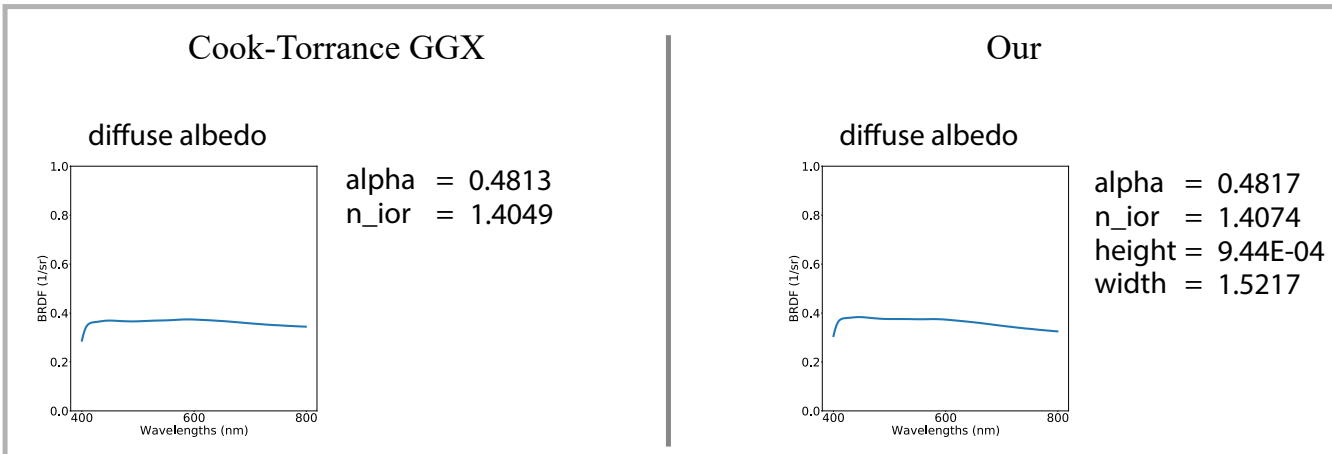
rgb image of in-plane BRDF



dE 2000

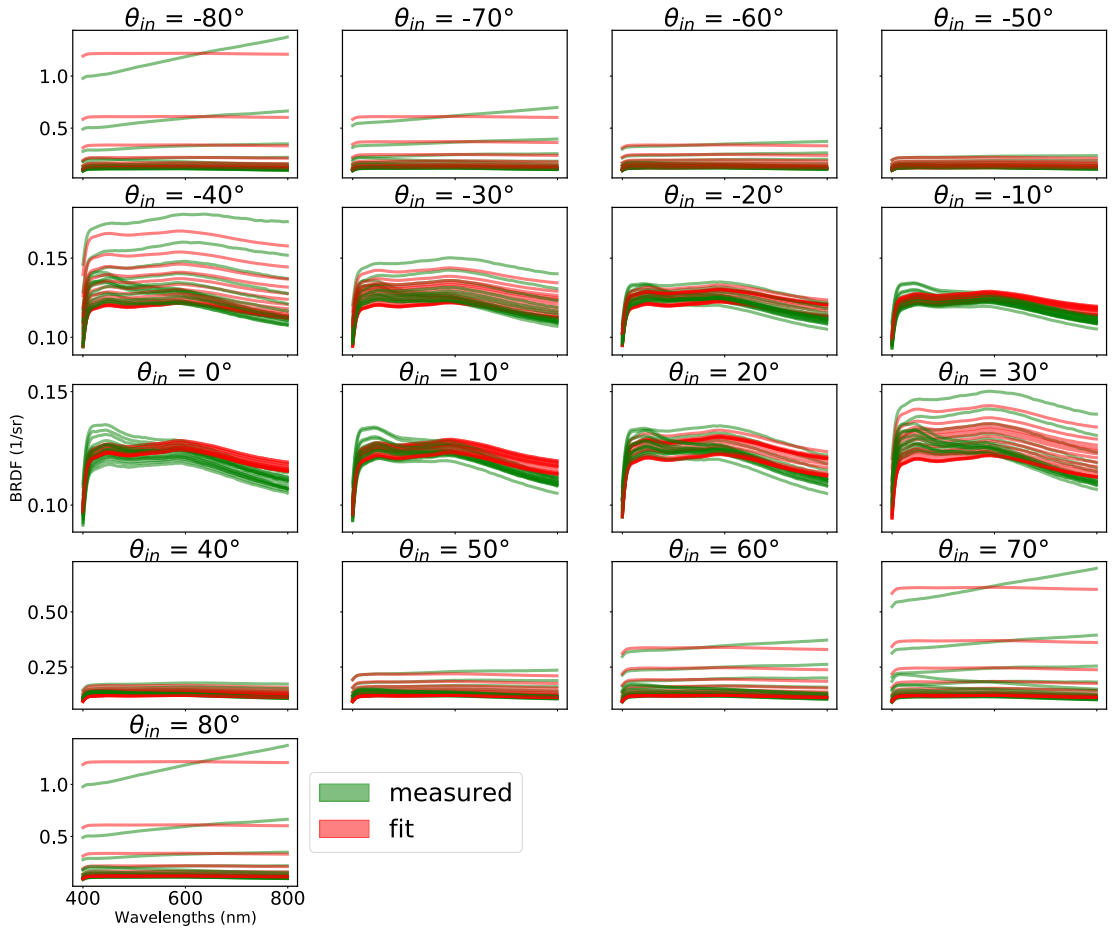


Fitting result

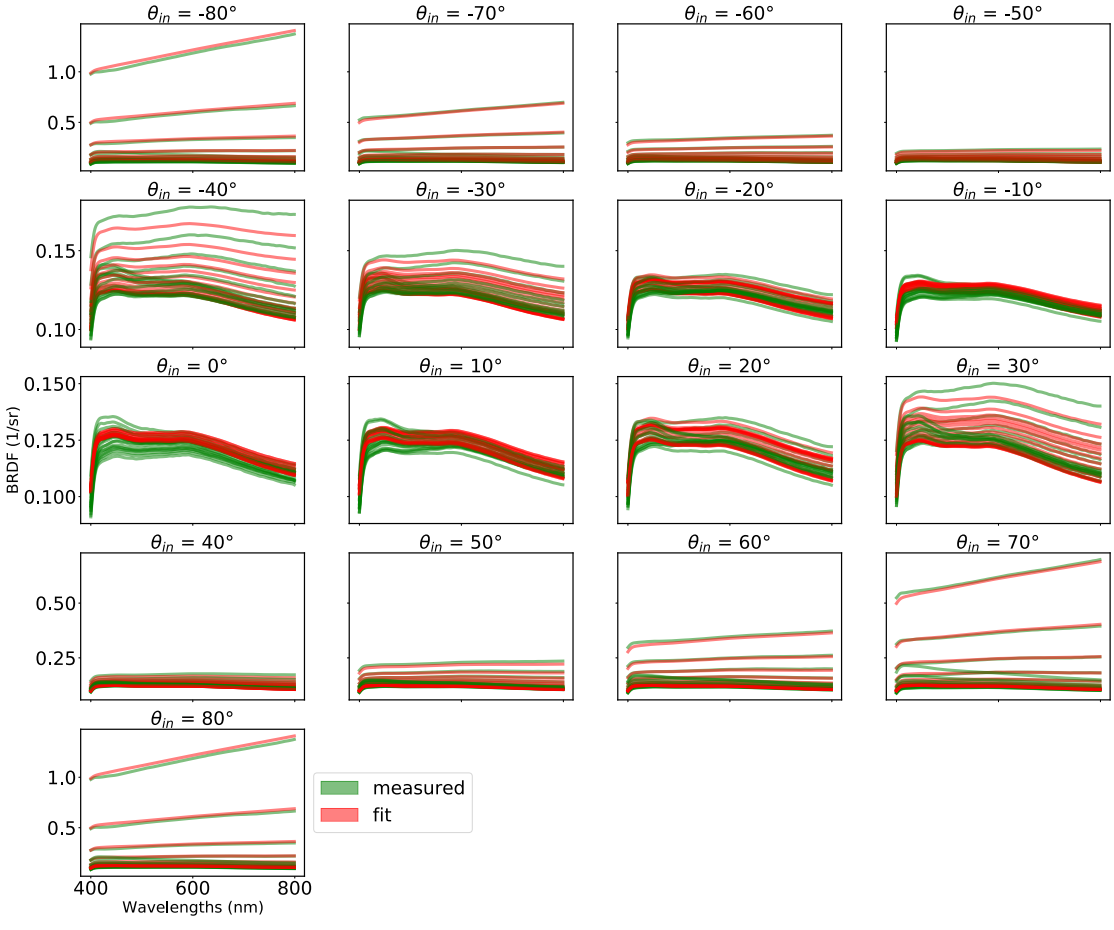


Measured vs. fitted spectra

Cook-Torrance GGX

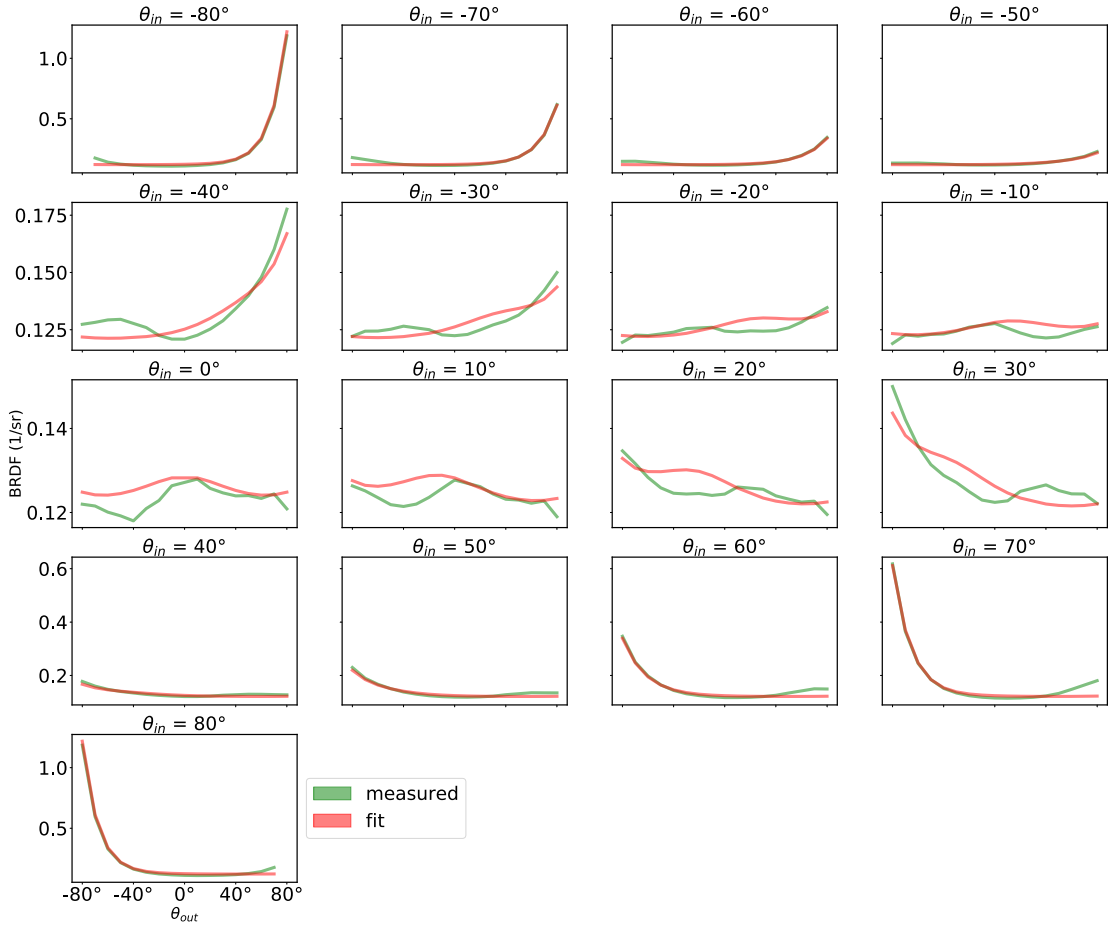


Our

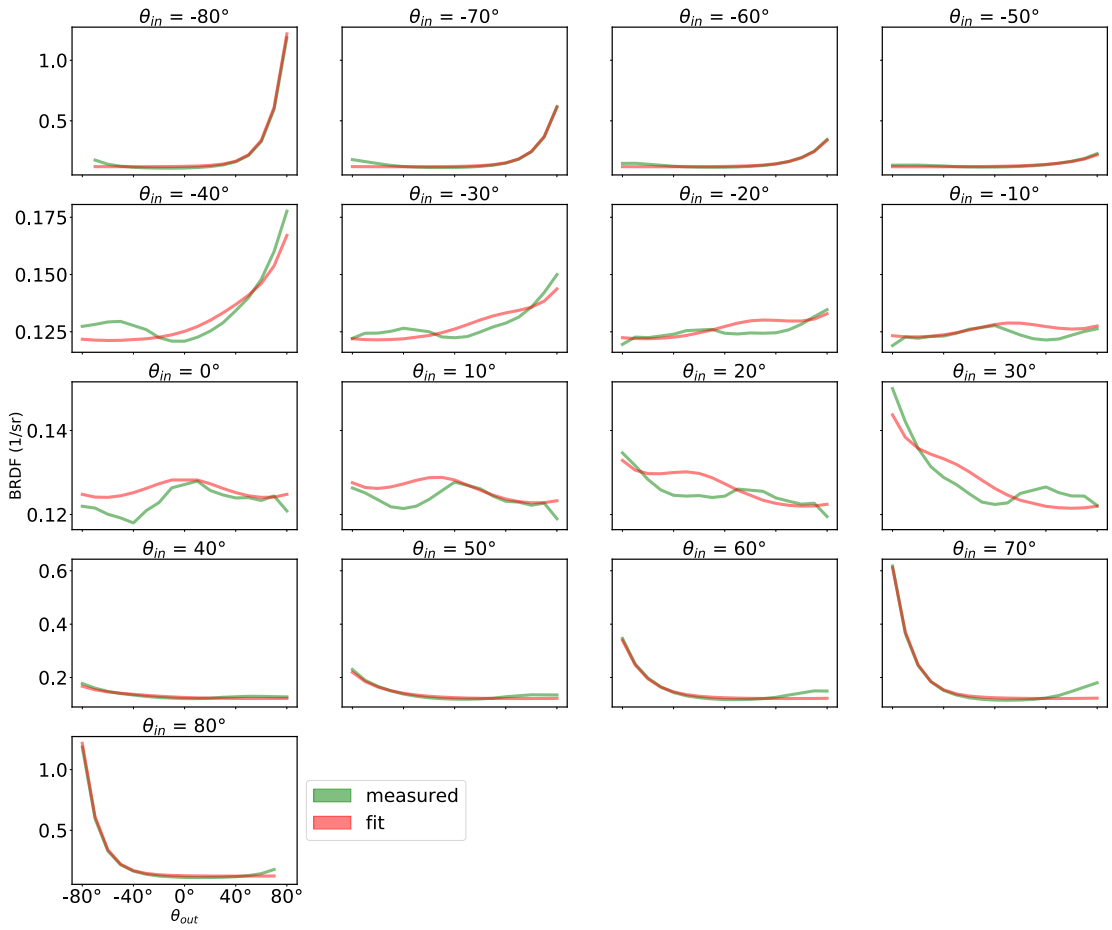


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



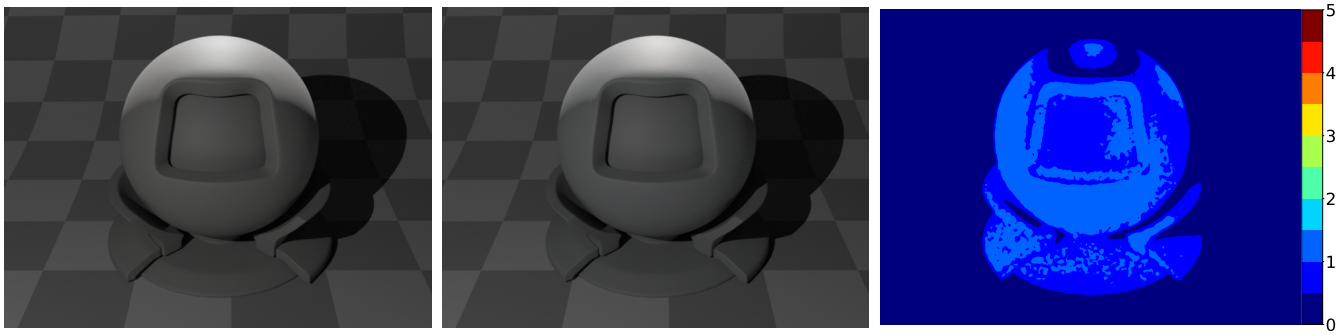
Our



ColorChecker - Patch 22

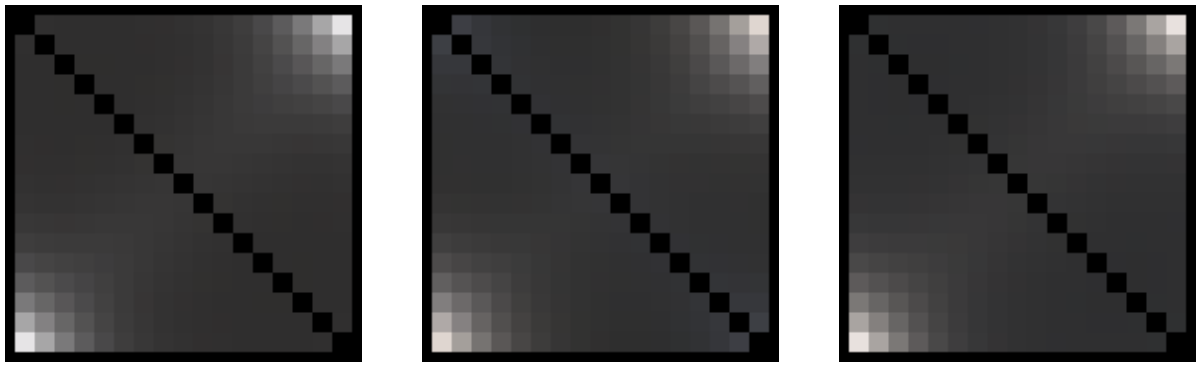
Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000



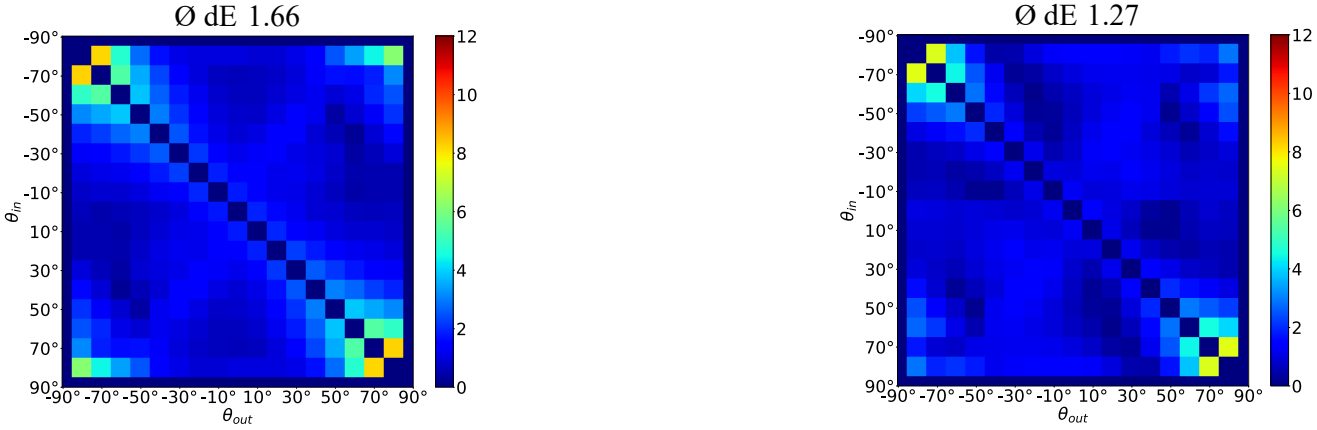
rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our



dE 2000

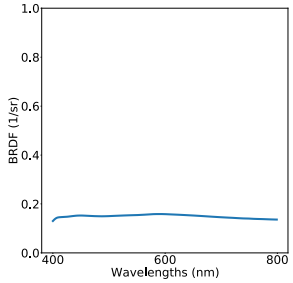
Ø dE 1.66 | Ø dE 1.27



Fitting result

Cook-Torrance GGX

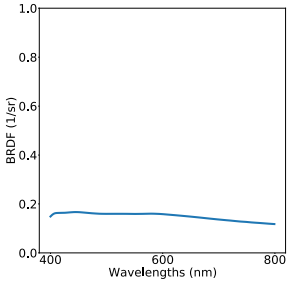
diffuse albedo



alpha = 0.4507
n_ior = 1.6643

Our

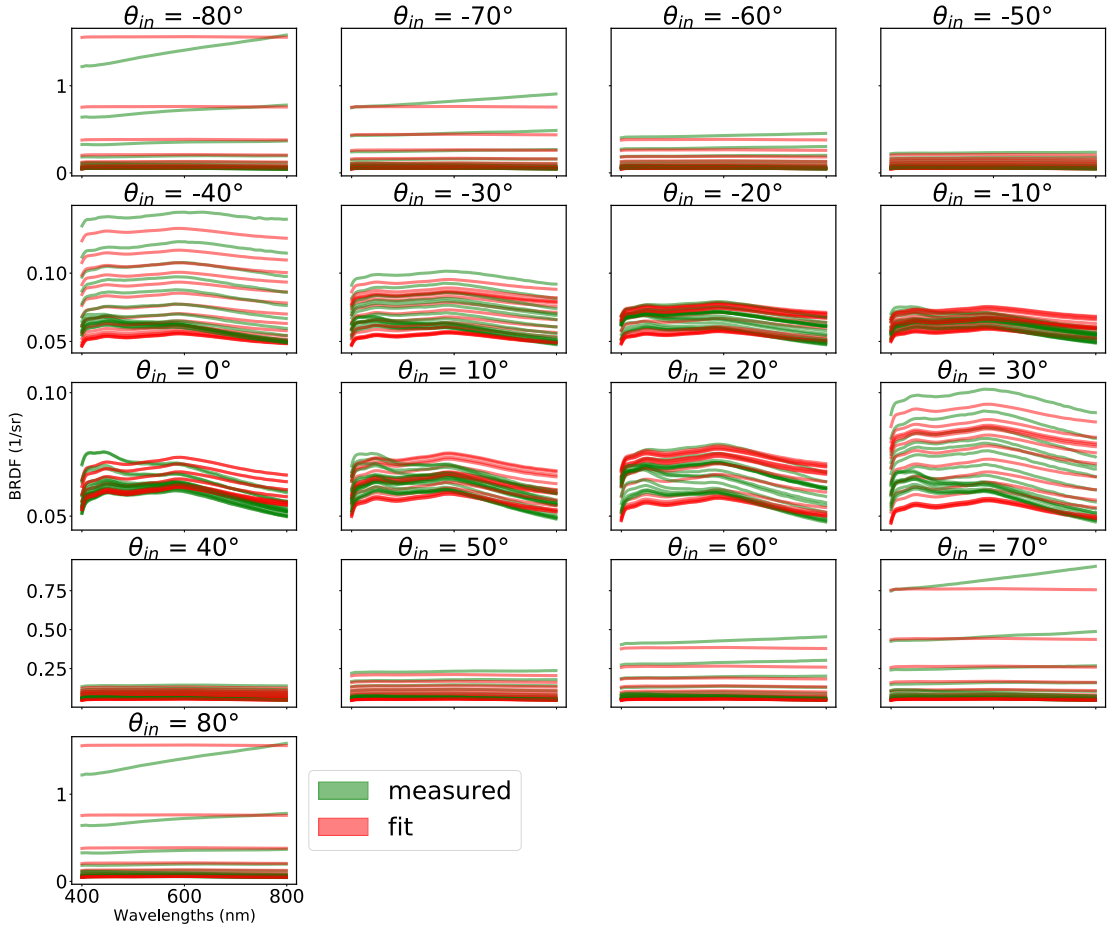
diffuse albedo



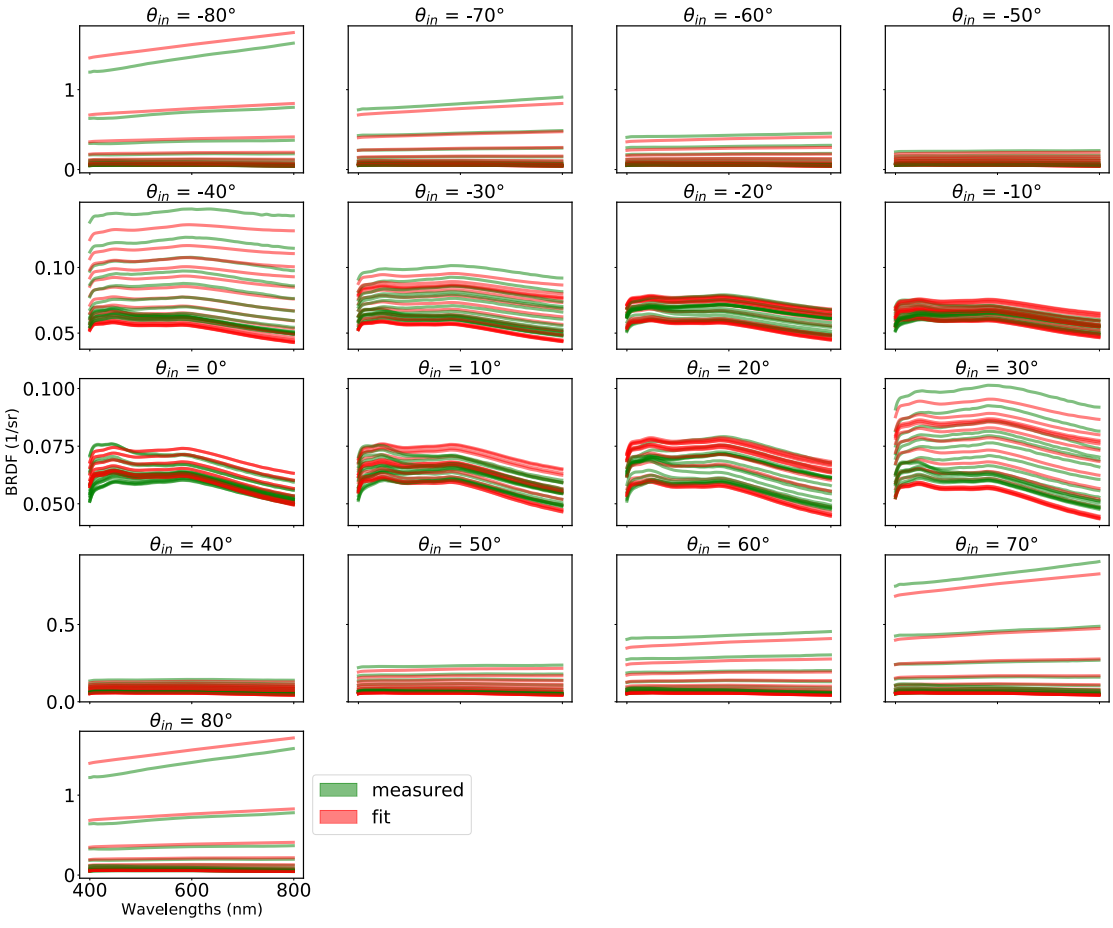
alpha = 0.4506
n_ior = 1.6638
height = 5.41E-04
width = 1.0188

Measured vs. fitted spectra

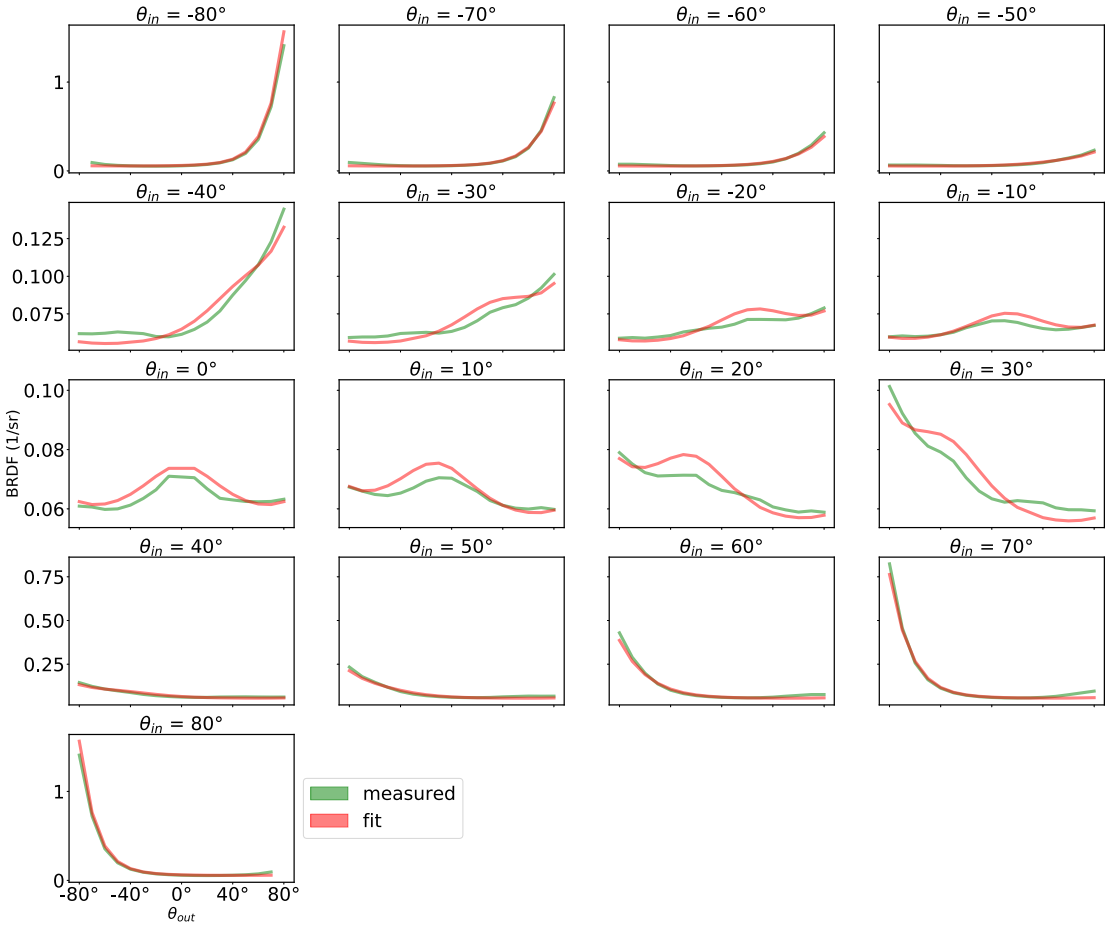
Cook-Torrance GGX

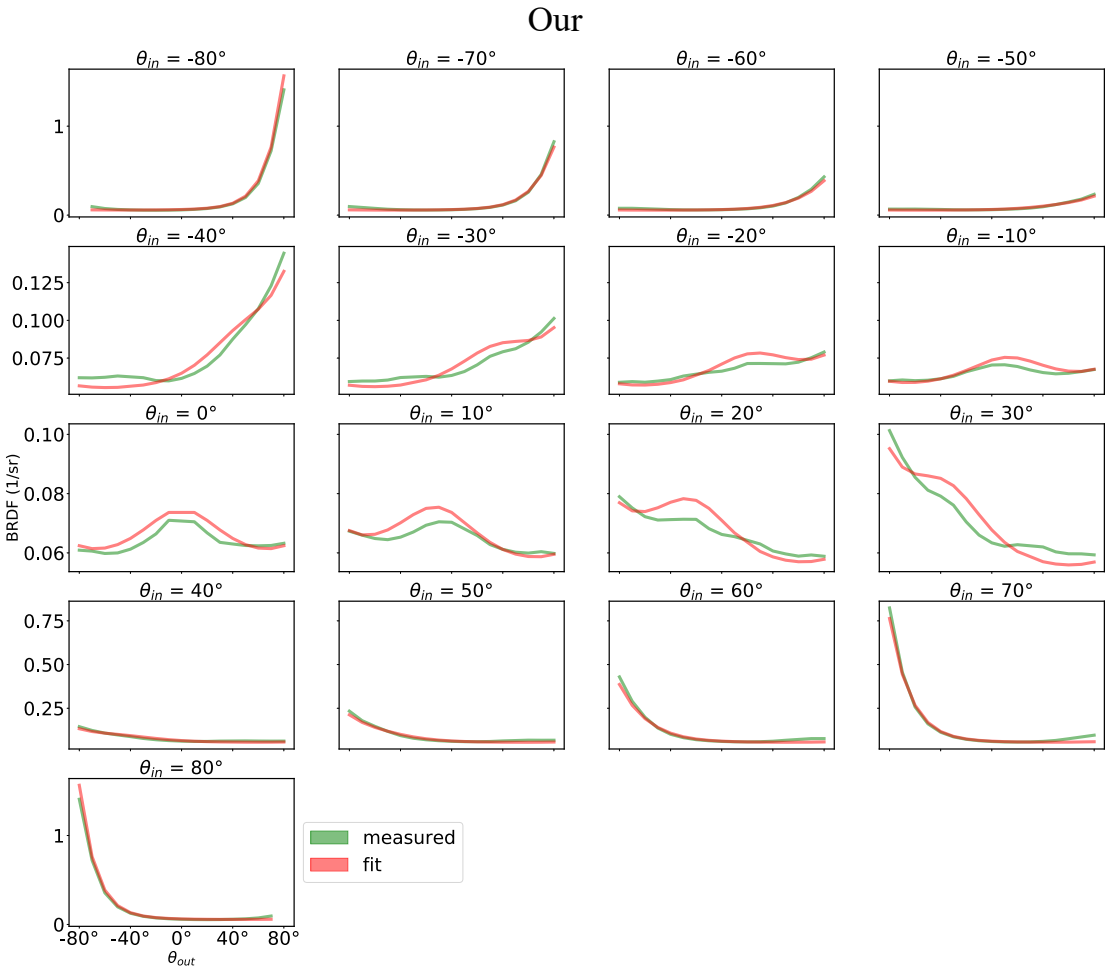


Our



Measured vs. fitted
scatter distribution at 600 nm

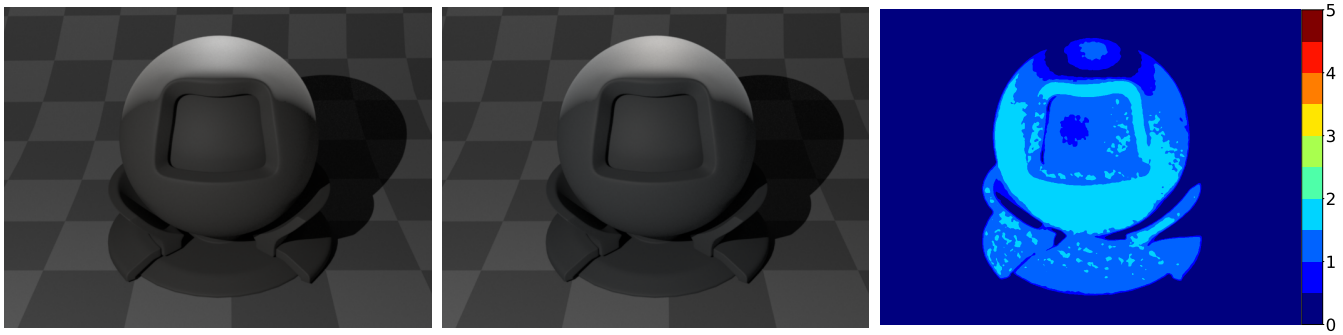




ColorChecker - Patch 23

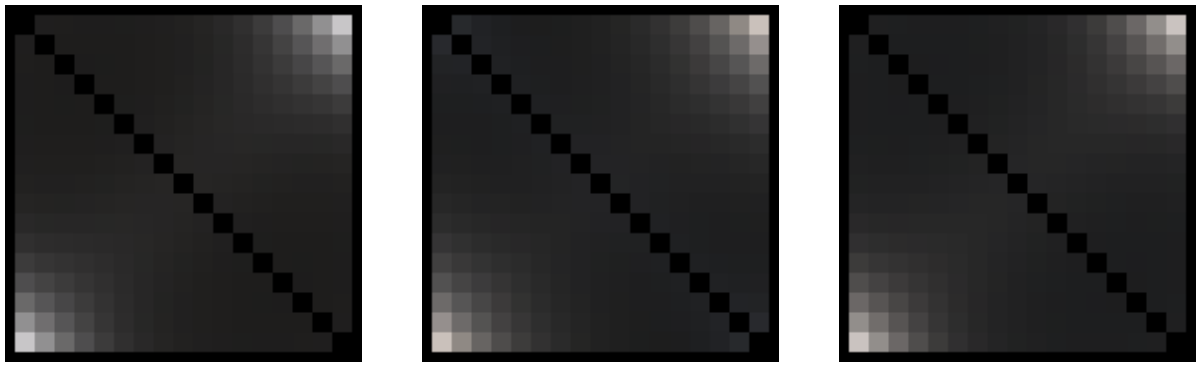
Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000



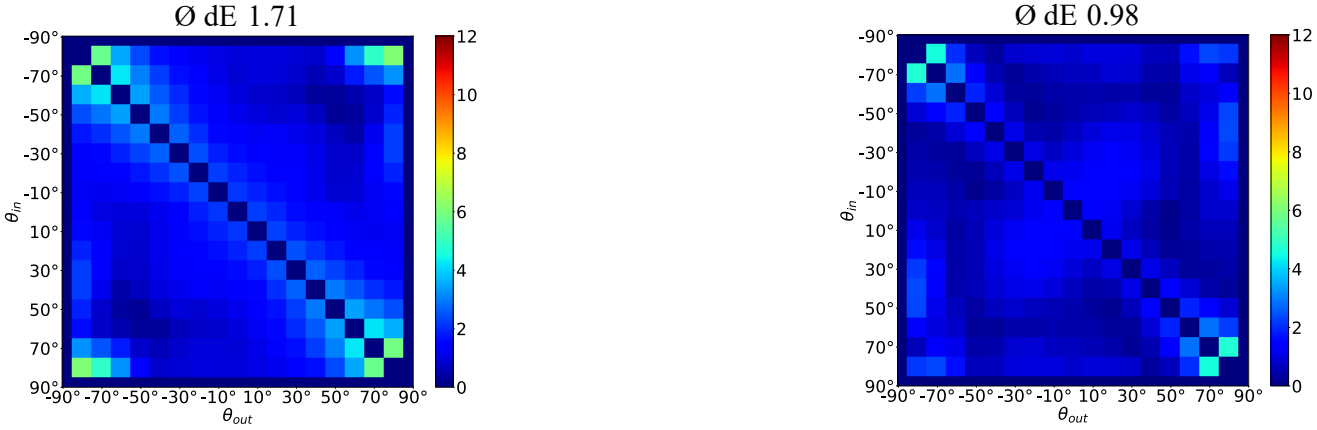
rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our



dE 2000

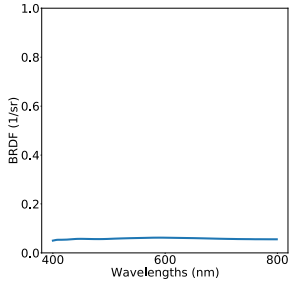
Ø dE 1.71 | Ø dE 0.98



Fitting result

Cook-Torrance GGX

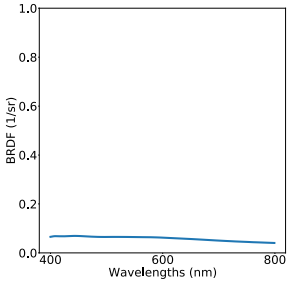
diffuse albedo



alpha = 0.4926
n_ior = 1.6169

Our

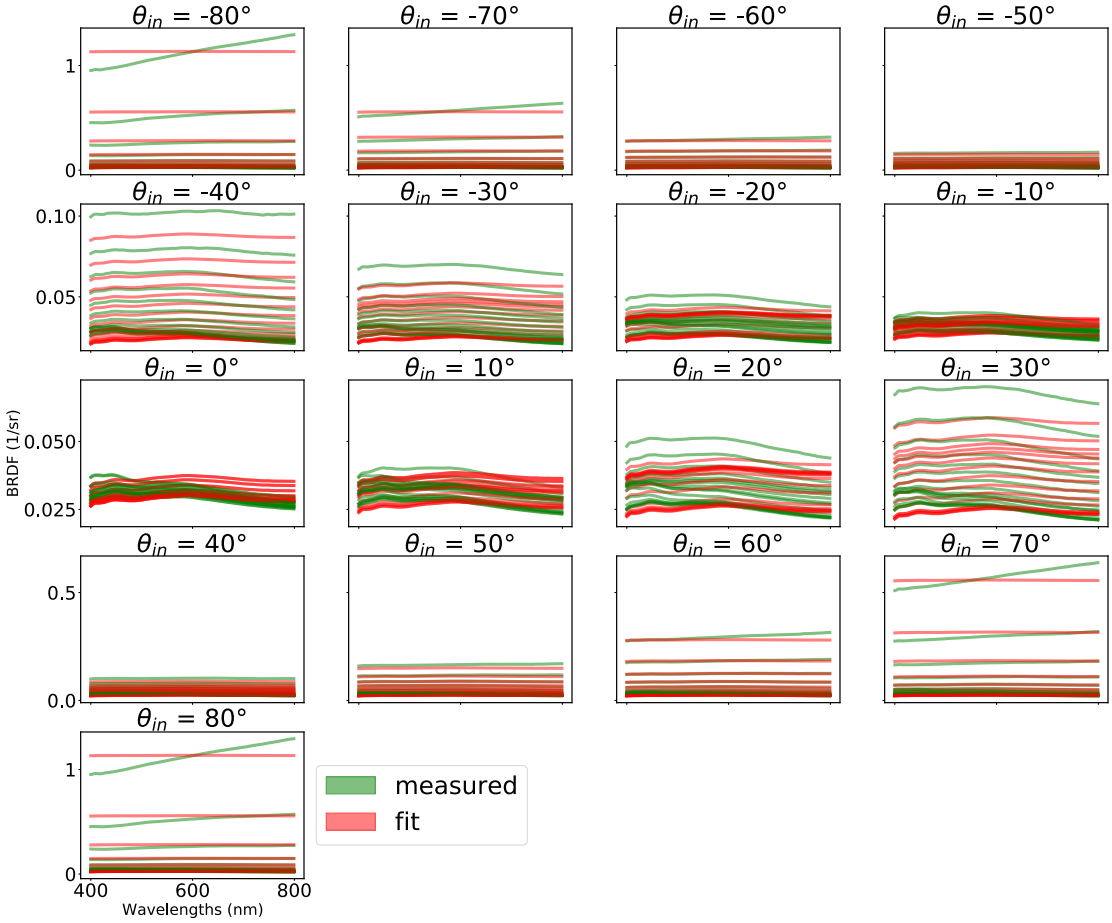
diffuse albedo



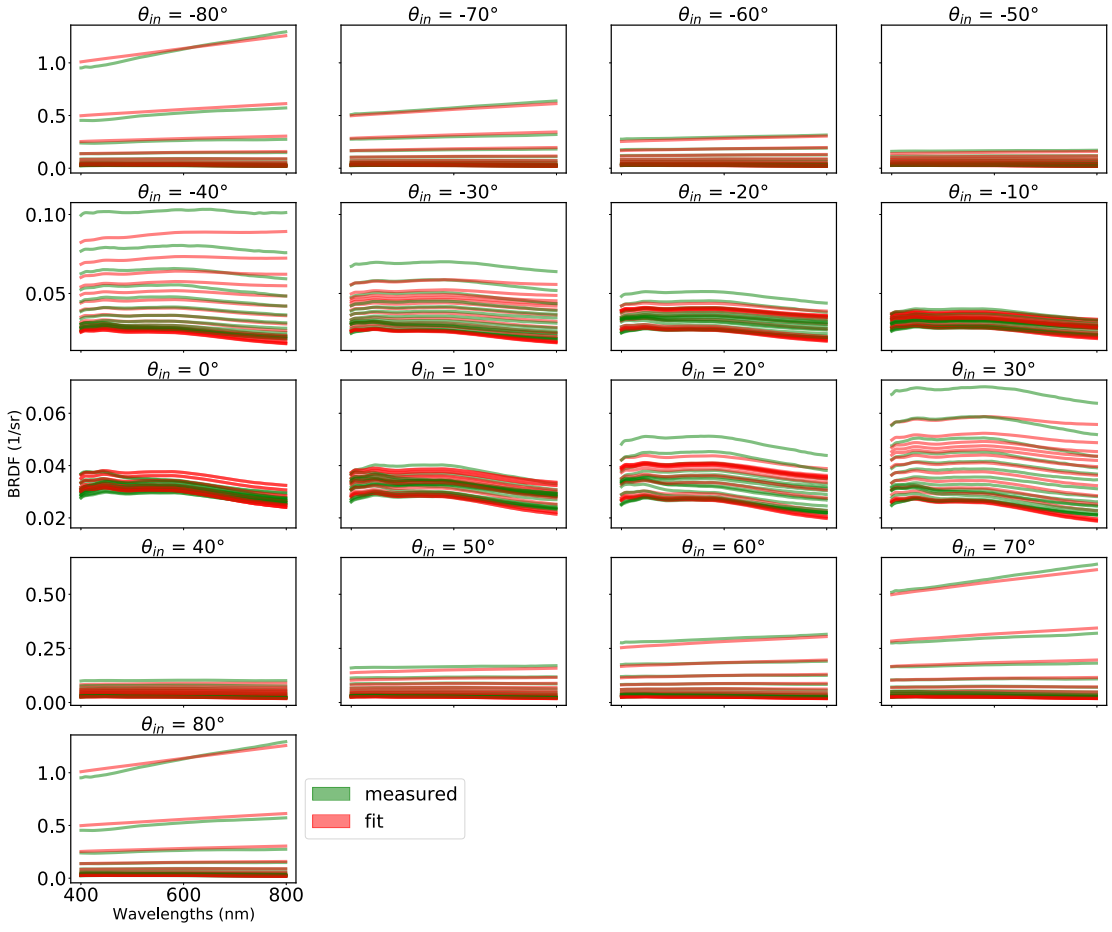
alpha = 0.4923
n_ior = 1.6145
height = 5.75E-04
width = 1.0013

Measured vs. fitted spectra

Cook-Torrance GGX

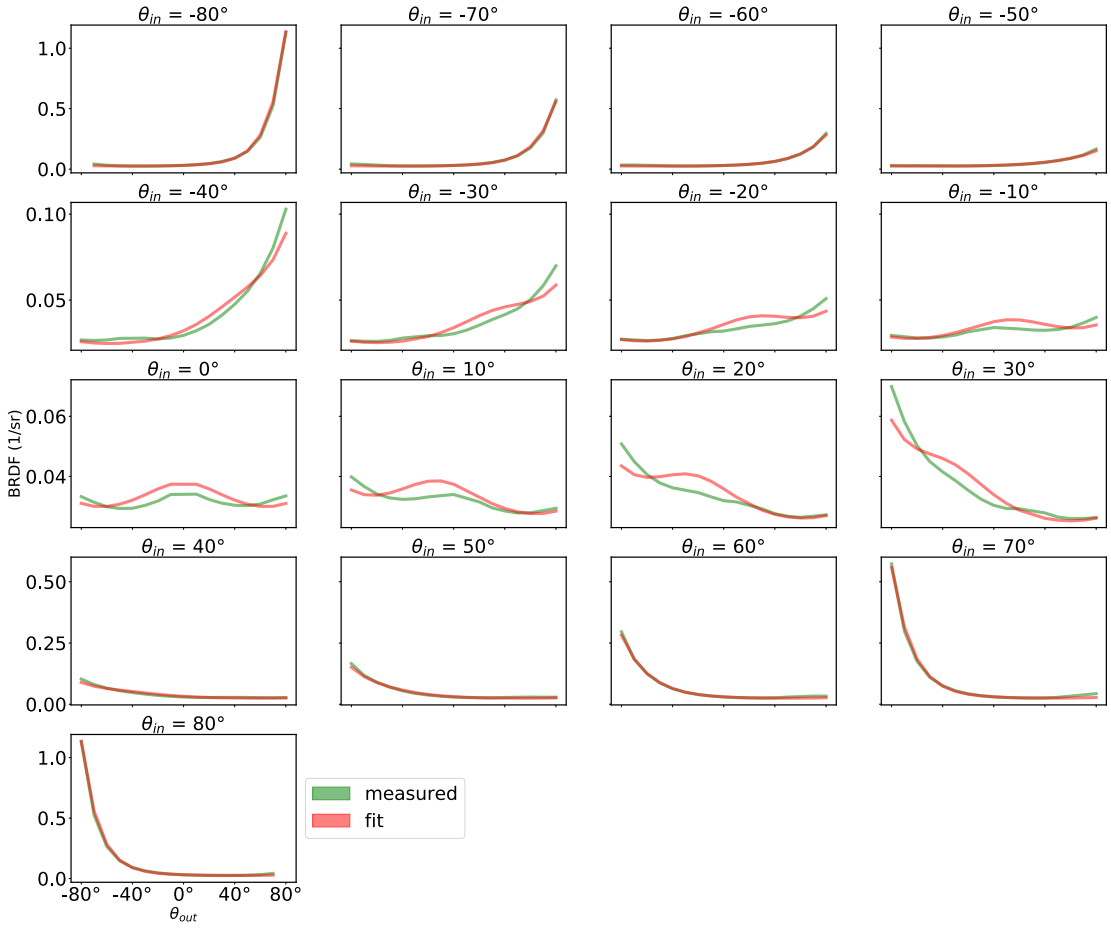


Our

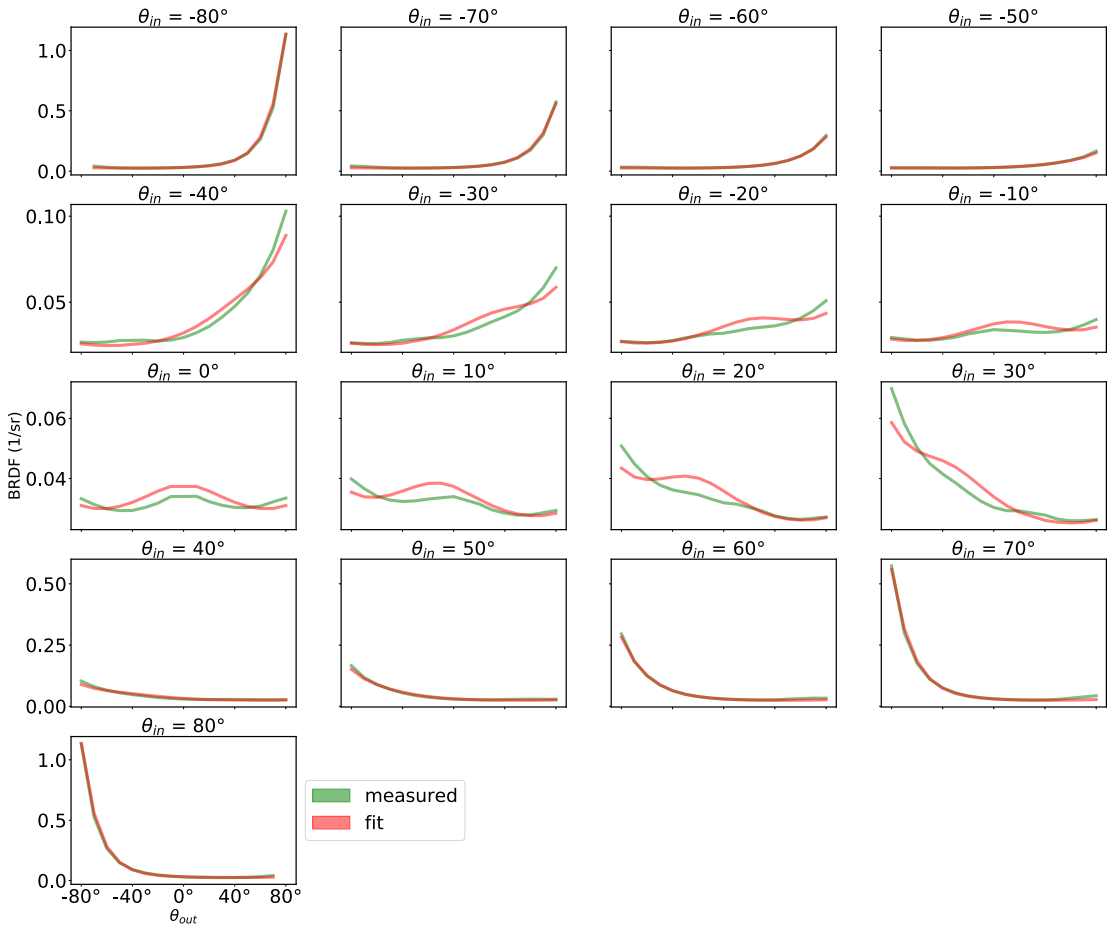


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



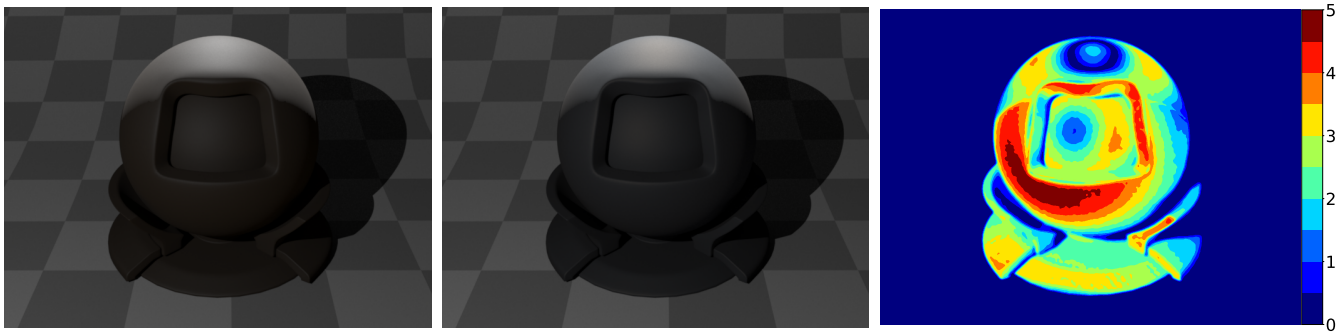
Our



ColorChecker - Patch 24

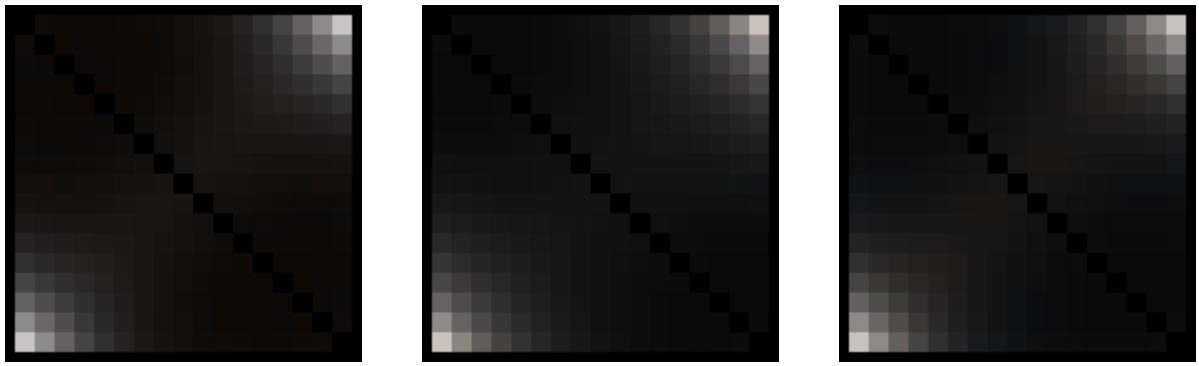
Rendering (Computed with Mitsuba 2)

Cook-Torrance GGX | Our | dE 2000



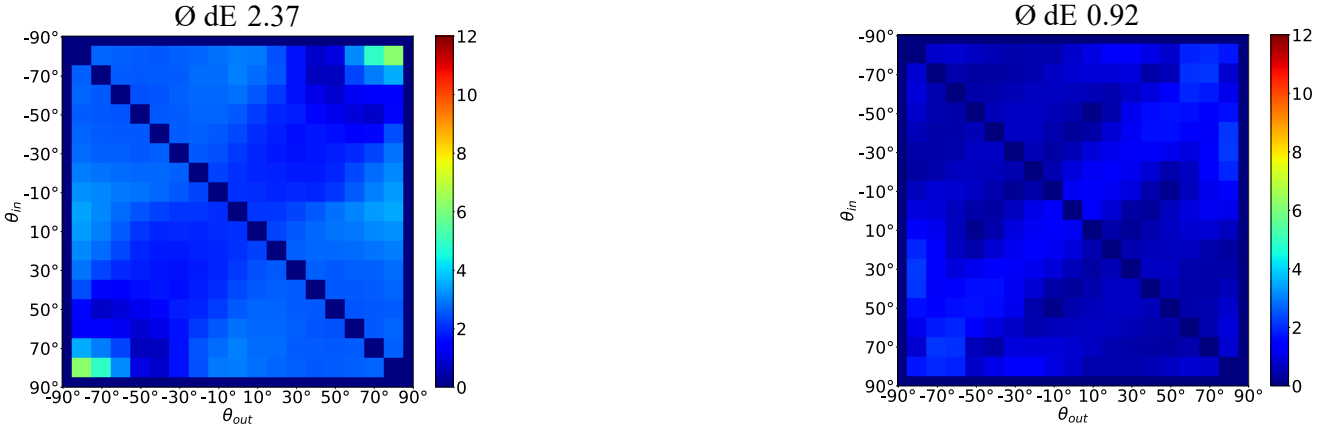
rgb image of in-plane BRDF

Cook-Torrance GGX | Measurement | Our



dE 2000

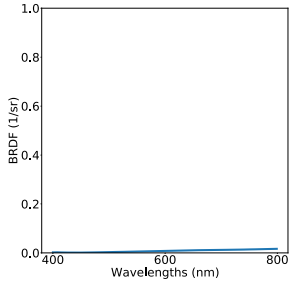
Ø dE 2.37 | Ø dE 0.92



Fitting result

Cook-Torrance GGX

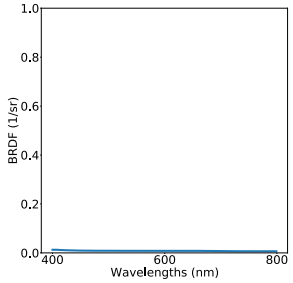
diffuse albedo



alpha = 0.4875
n_ior = 1.4973

Our

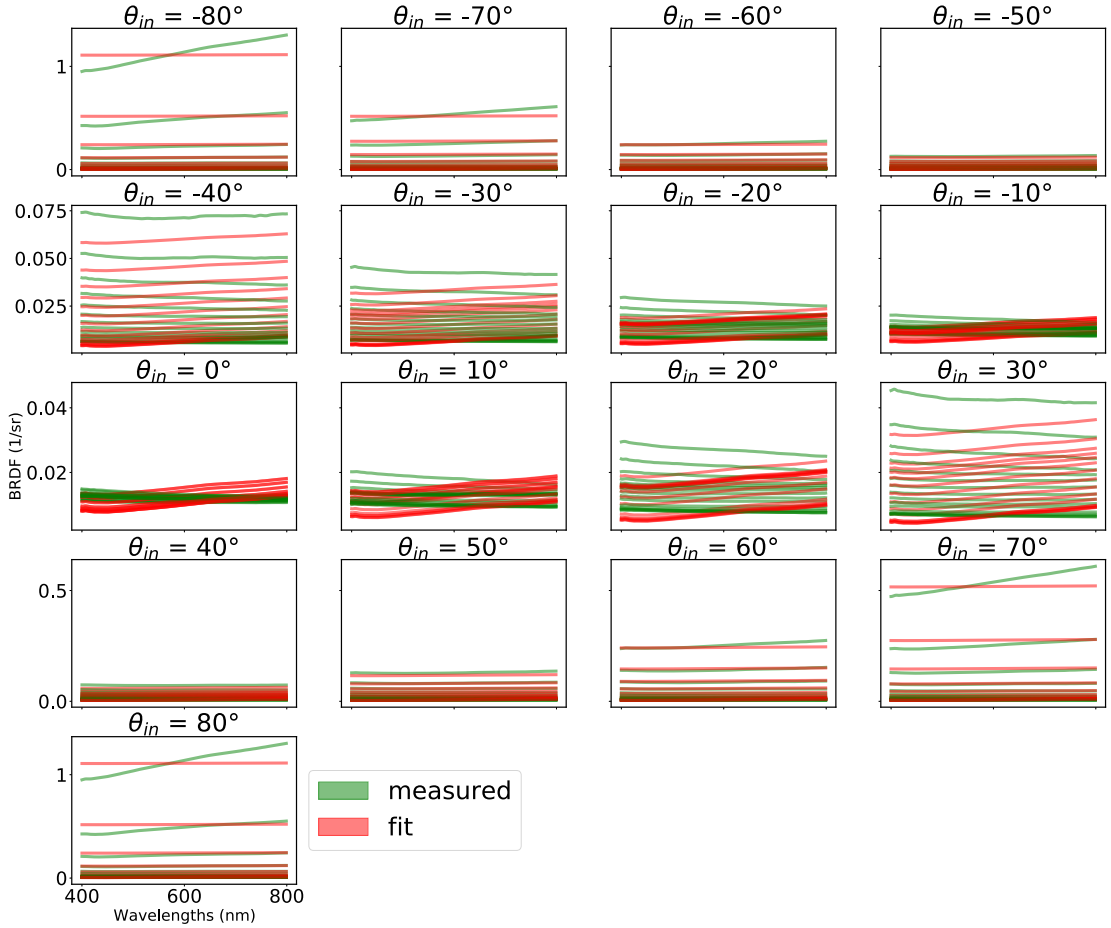
diffuse albedo



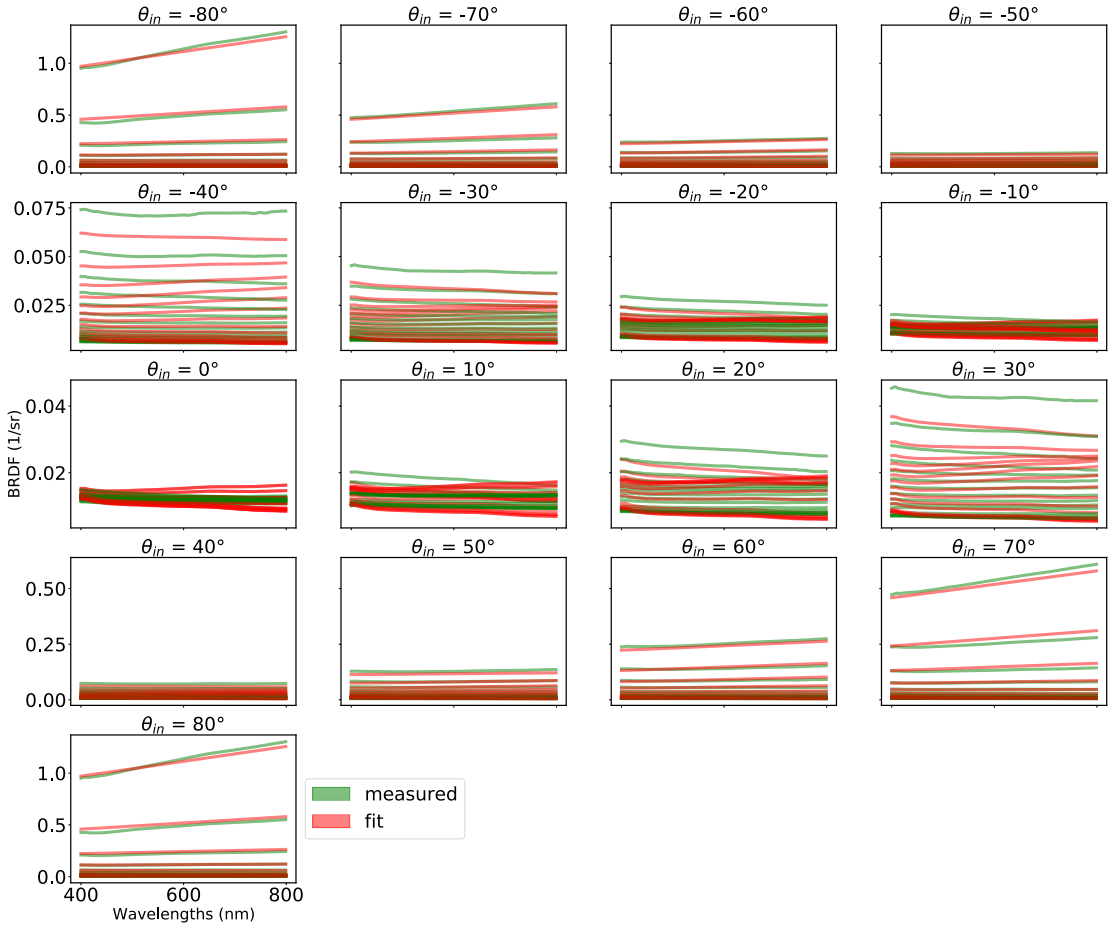
alpha = 0.4869
n_ior = 1.4936
height = 6.48E-04
width = 4.7576

Measured vs. fitted spectra

Cook-Torrance GGX

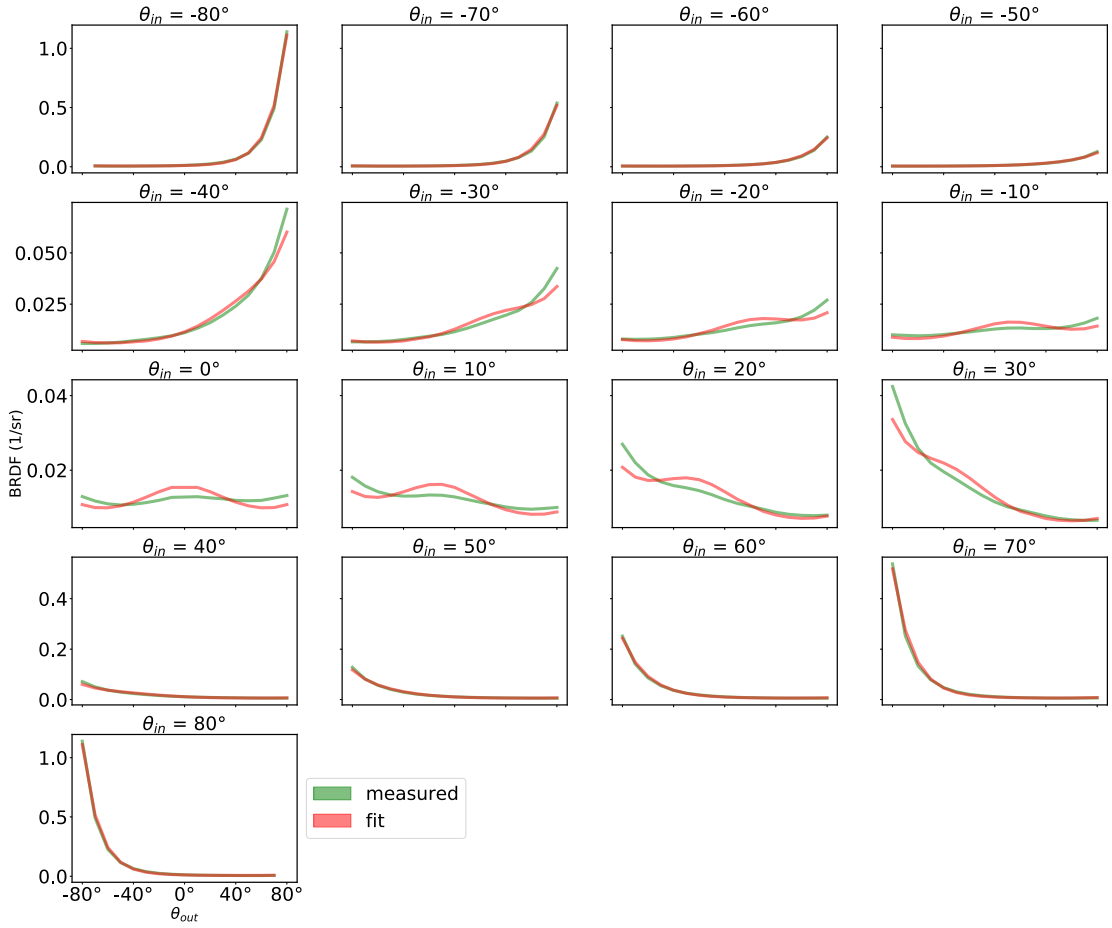


Our

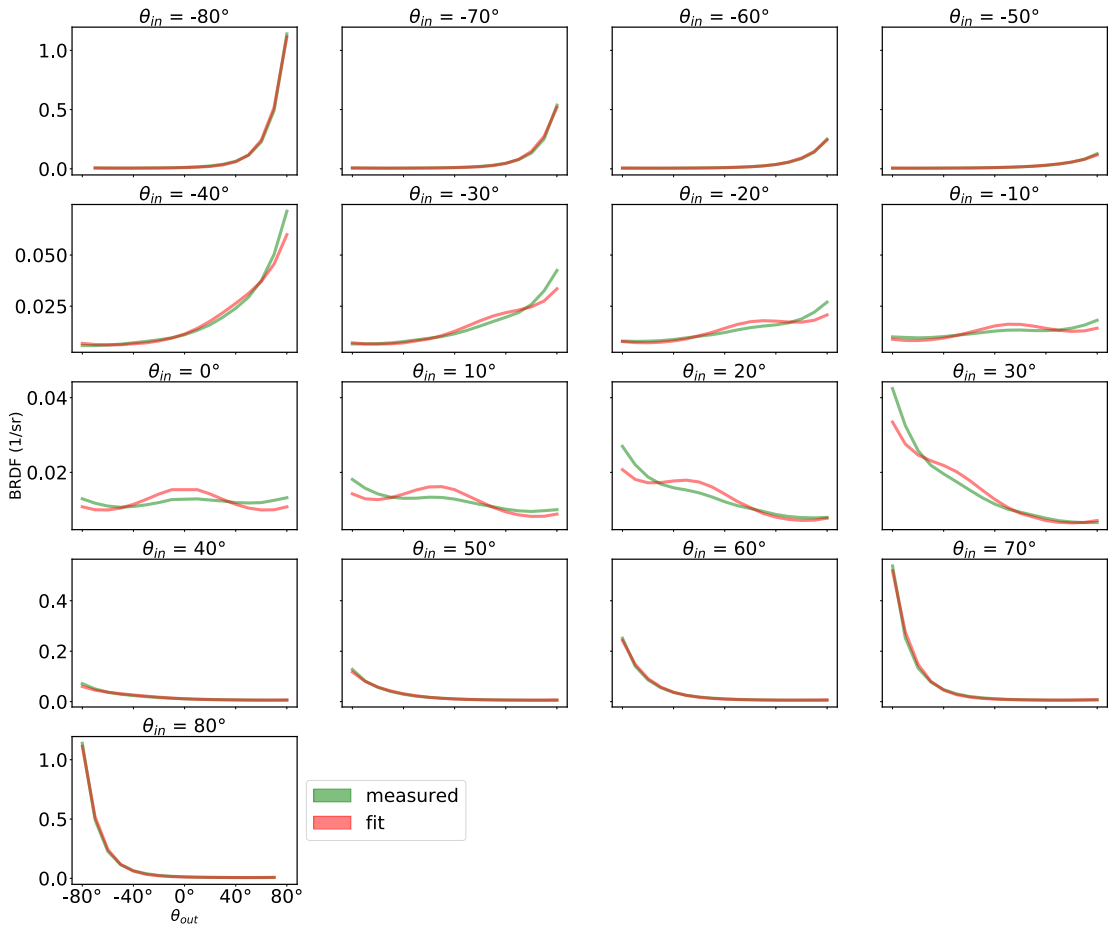


Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX

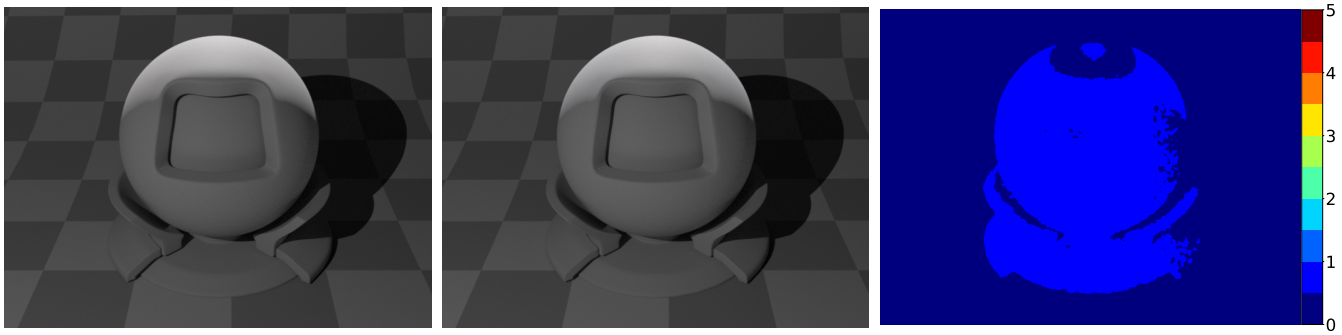


Our



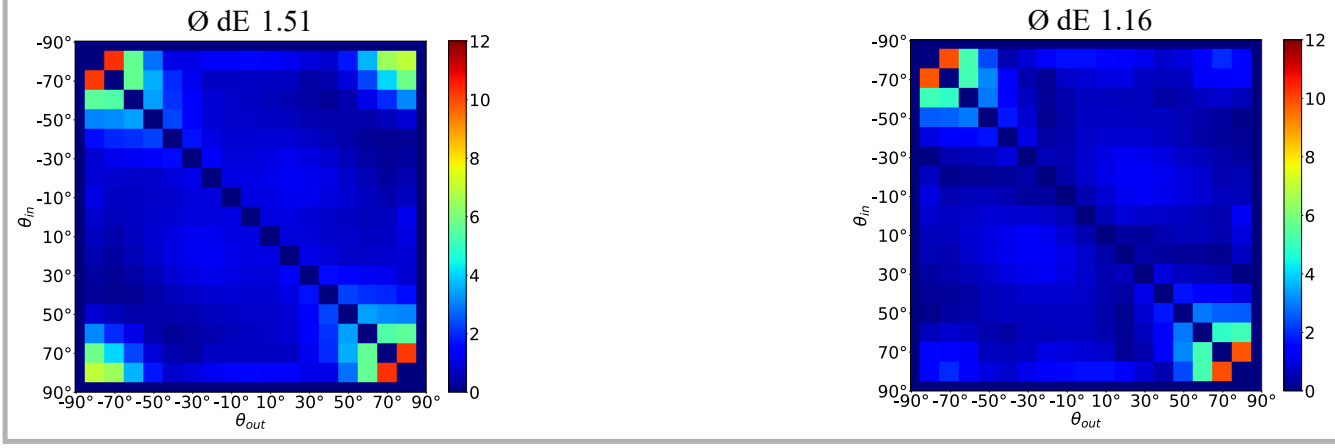
Grey wall paint

Rendering
(Computed with Mitsuba 2)

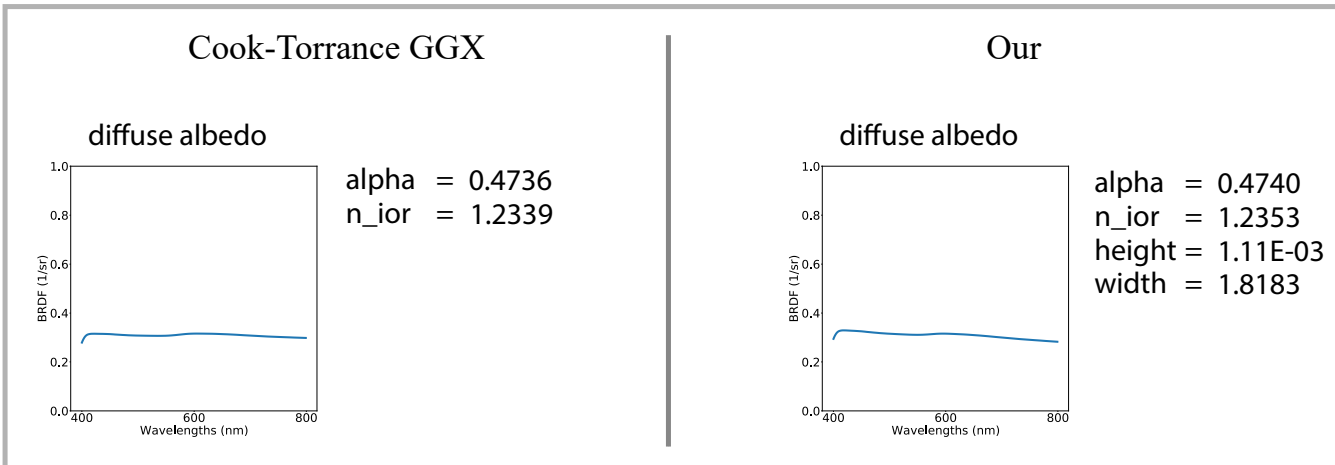


rgb image of
in-plane BRDF

dE 2000

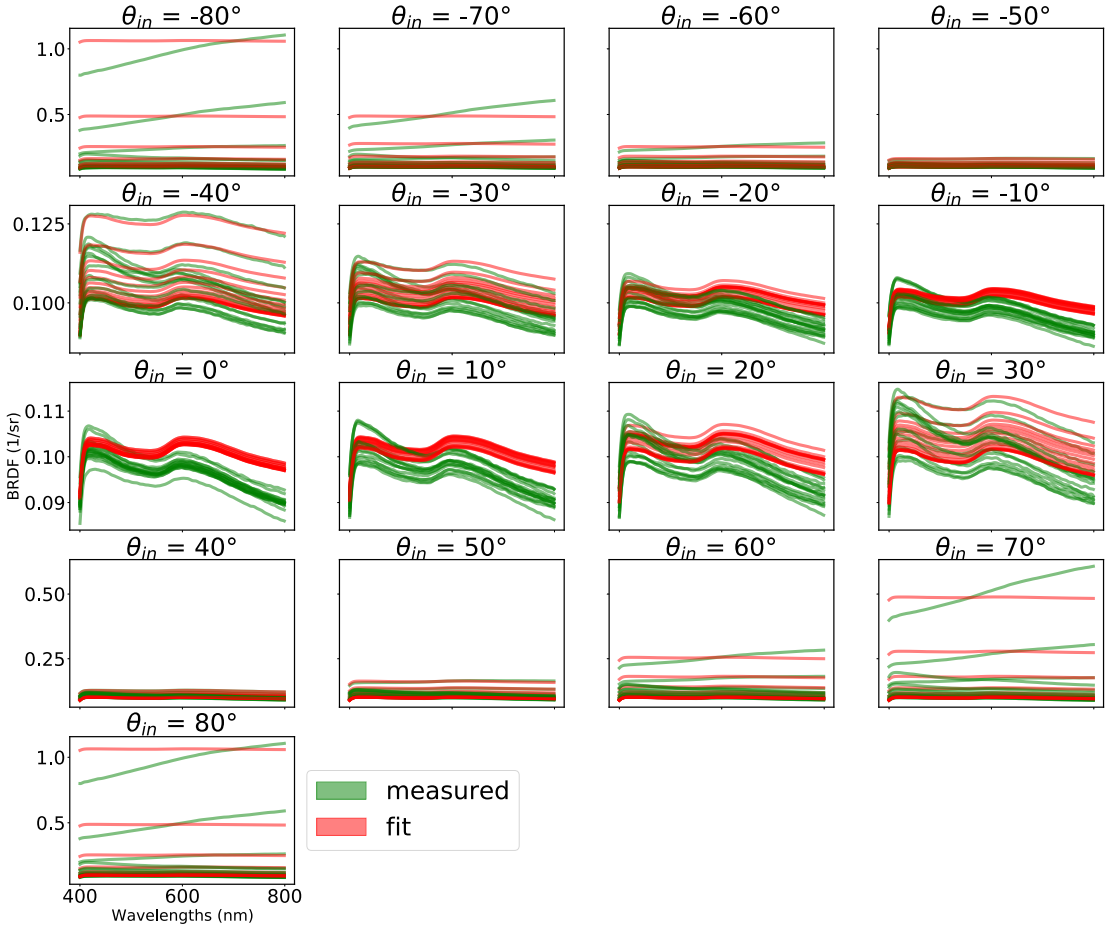


Fitting result

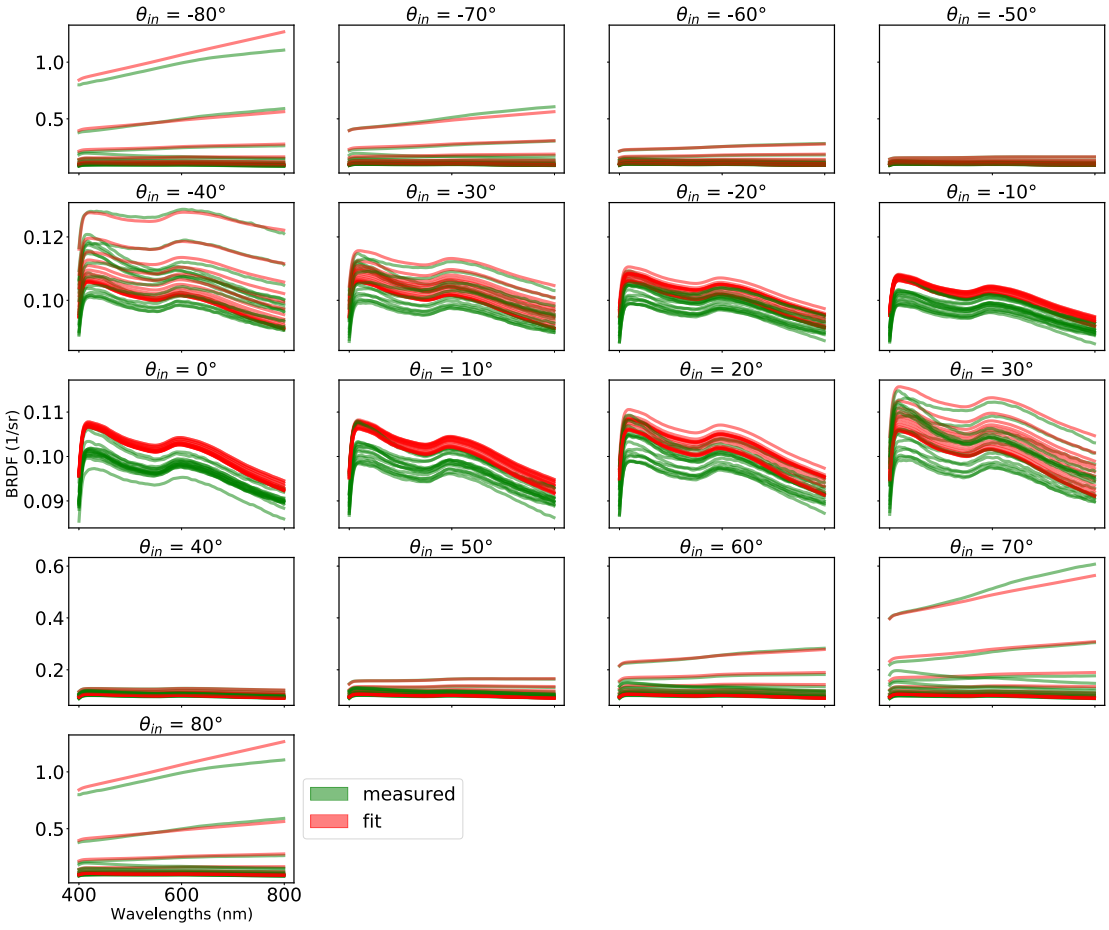


Measured vs. fitted spectra

Cook-Torrance GGX

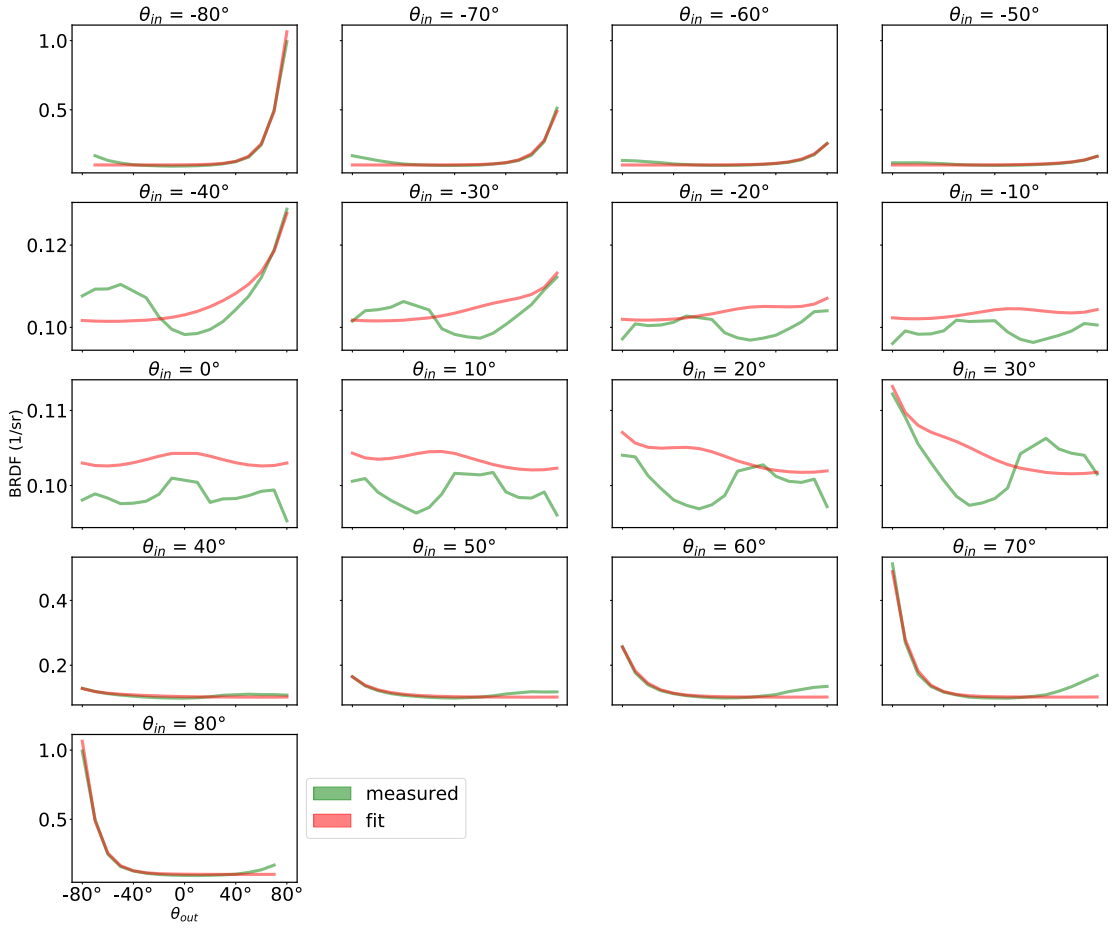


Our



Measured vs. fitted
scatter distribution at 600 nm

Cook-Torrance GGX



Our