On Optimal, Minimal BRDF Sampling for Reflectance Acquisition
Supplementary material

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1 RMS Errors

The following figures present RMS errors for reconstructions of all 100 MERL materials. The reconstructions are done using our 5 best points of sampling (blue), and the 5 common industry directions (red). PC projections (dashed lines) are omitted as the materials are part of the PC training.

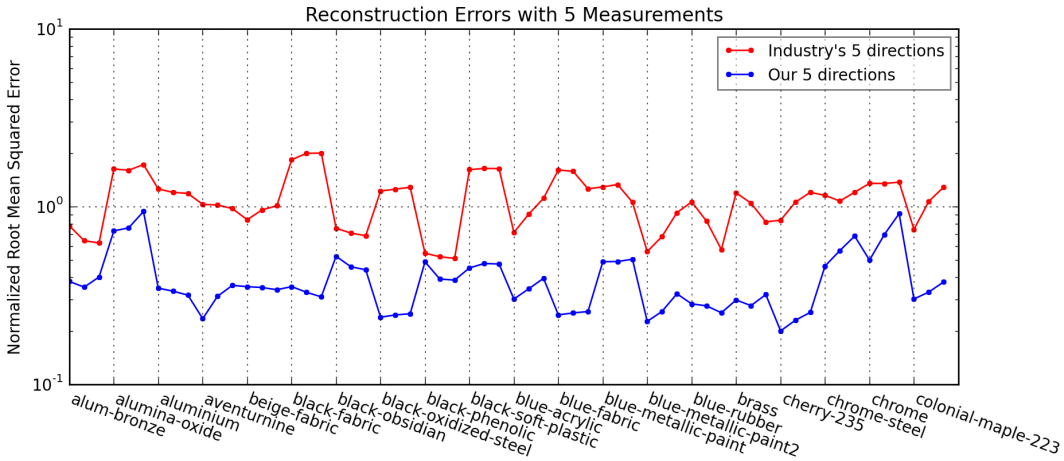

Figure 1: *RMS error of reconstruction of mapped BRDFs normalized by mean mapped BRDF value, using (blue) our 5 best points of sampling, (red) 5 common industry directions.*

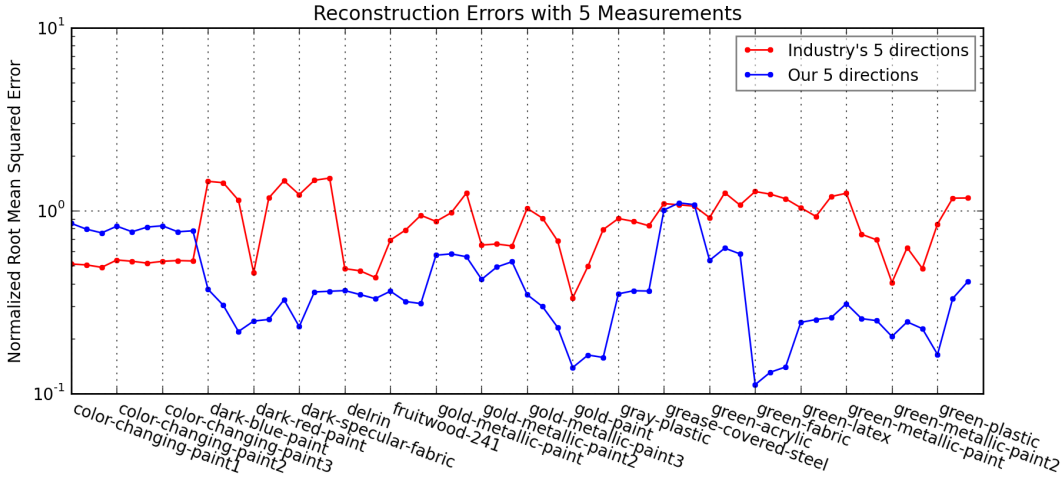

Figure 2: *RMS error of reconstruction of mapped BRDFs normalized by mean mapped BRDF value, using (blue) our 5 best points of sampling, (red) 5 common industry directions.*

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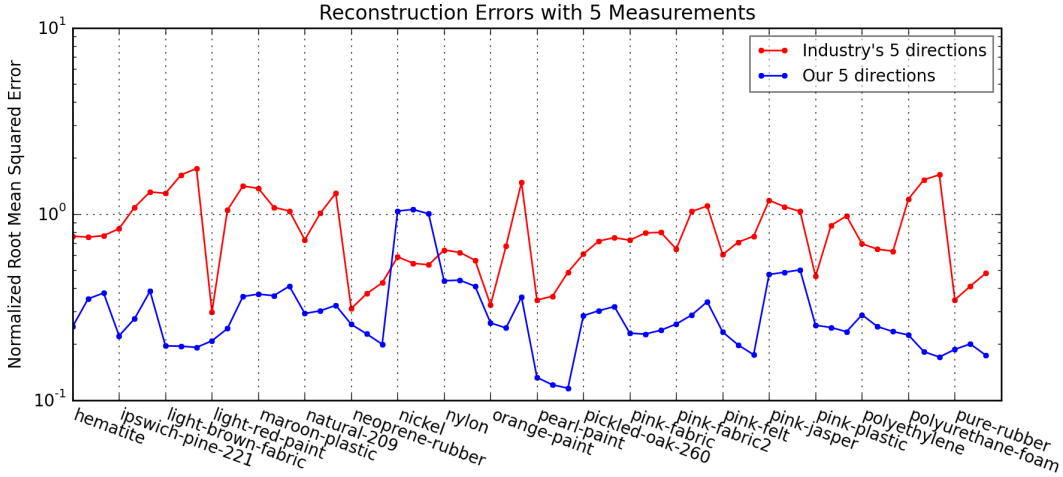

Figure 3: *RMS error of reconstruction of mapped BRDFs normalized by mean mapped BRDF value, using (blue) our 5 best points of sampling, (red) 5 common industry directions.*

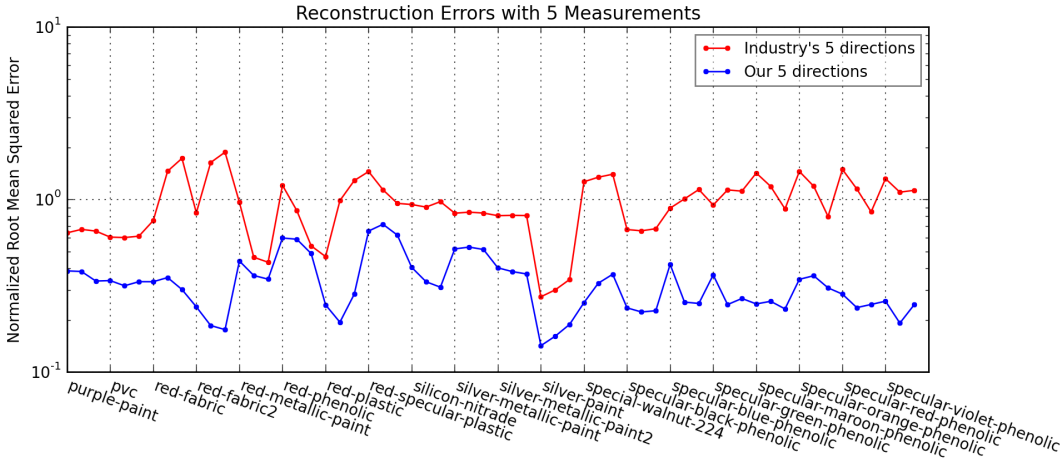

Figure 4: *RMS error of reconstruction of mapped BRDFs normalized by mean mapped BRDF value, using (blue) our 5 best points of sampling, (red) 5 common industry directions.*

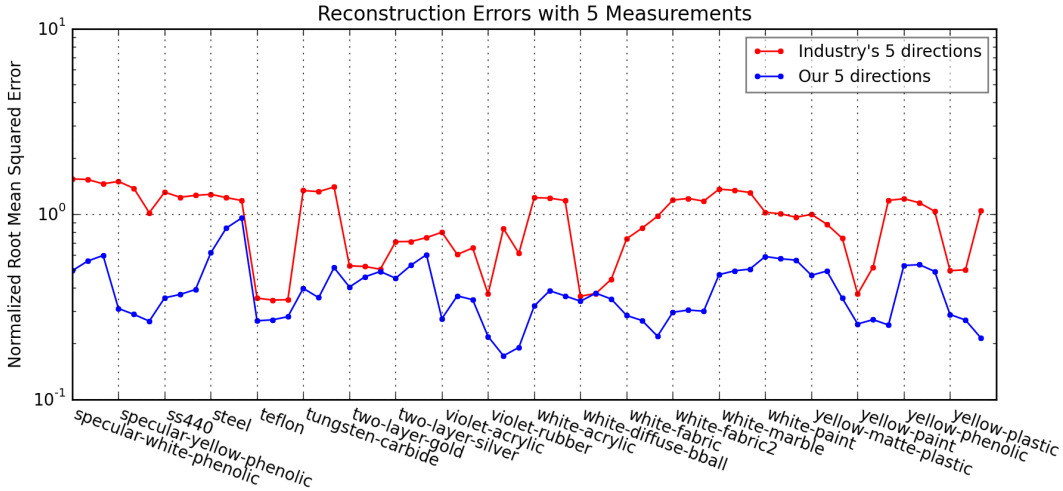

Figure 5: *RMS error of reconstruction of mapped BRDFs normalized by mean mapped BRDF value, using (blue) our 5 best points of sampling, (red) 5 common industry directions.*

2 Quality Matrices

2.1 MERL

Reconstructions of all 100 MERL materials using an increasing number of samples, n. Note in the reference images that for some materials (e.g. alumina-oxide, beige-fabric, nylon, pink-fabric) measurement artifacts are present. Generally our method handles these well.

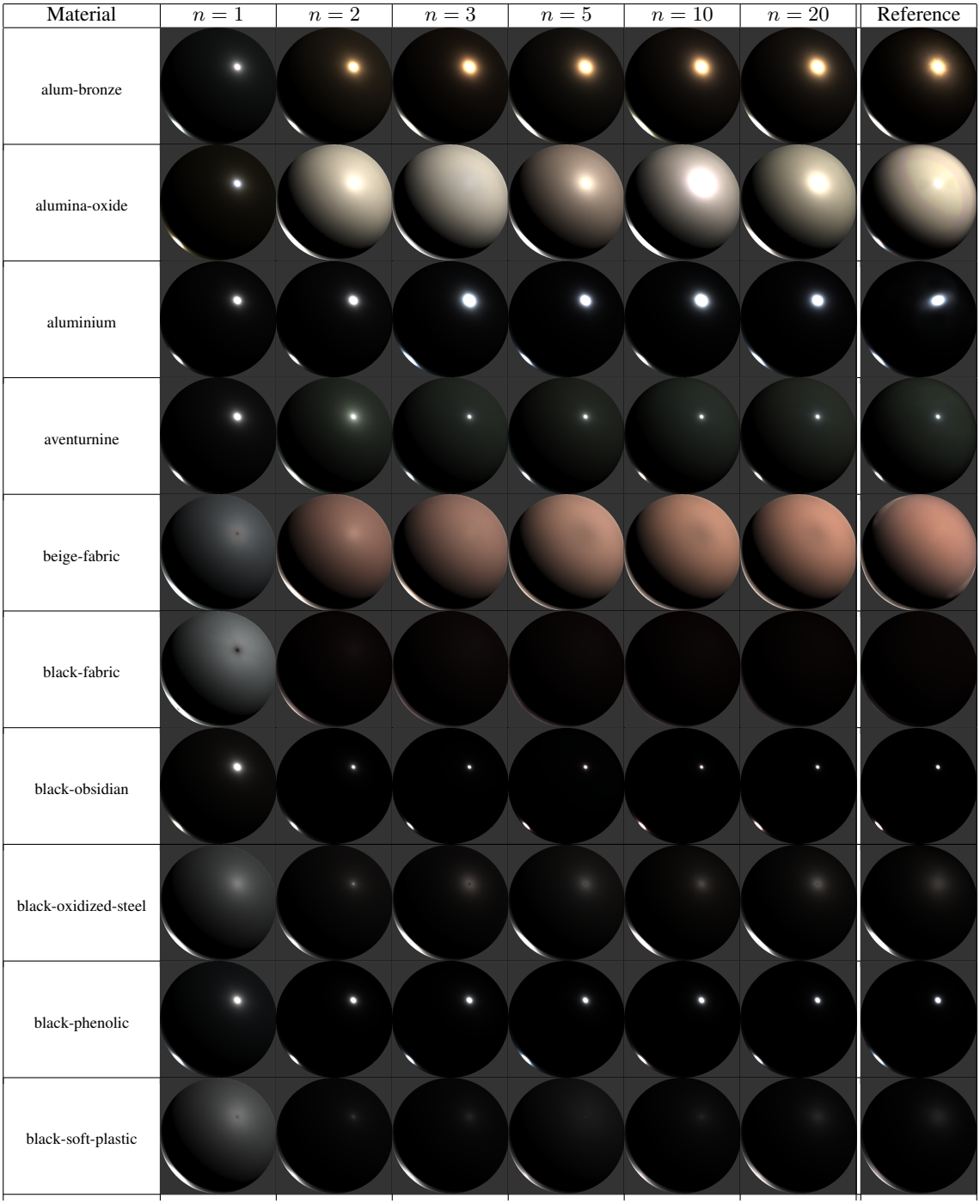

Figure 6: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

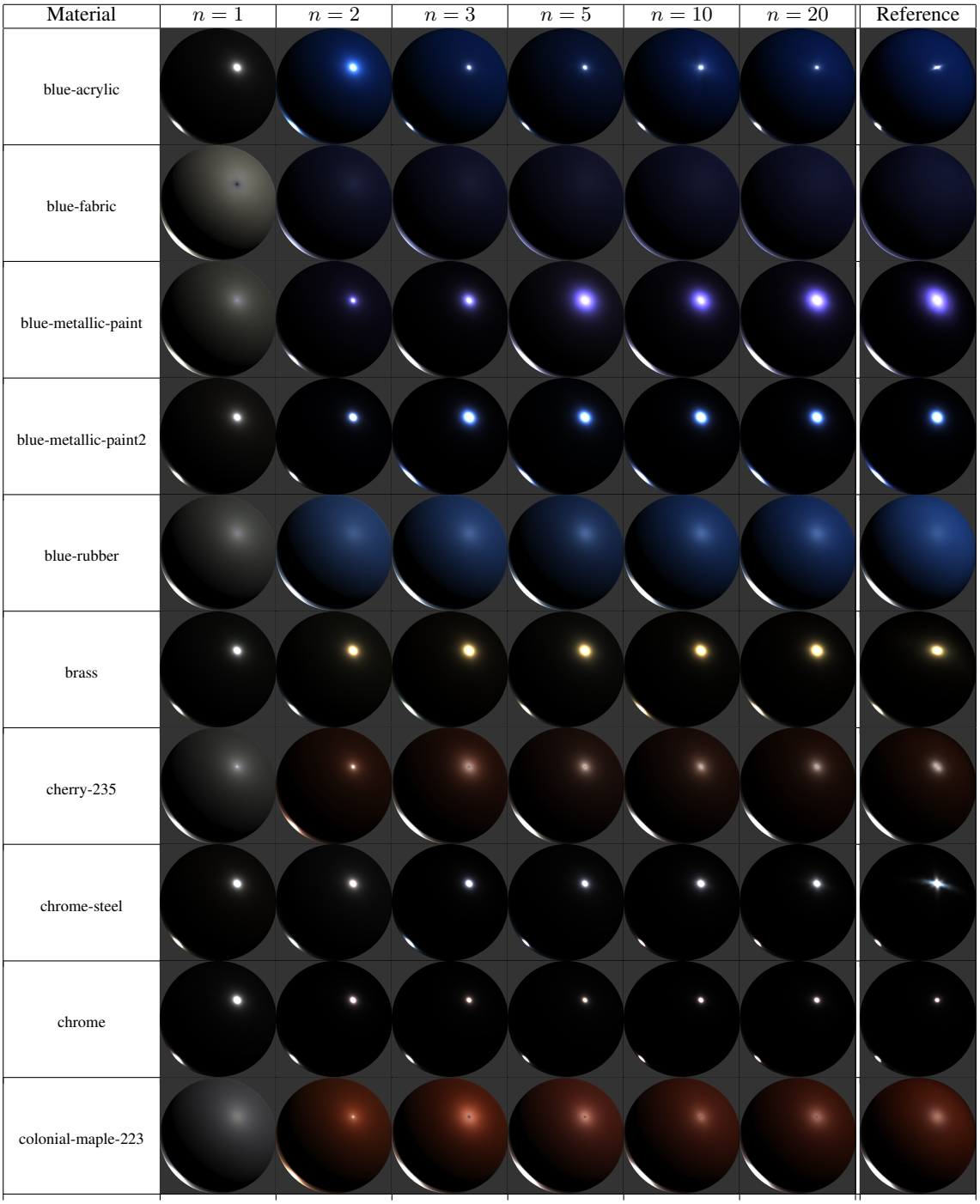

Figure 7: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

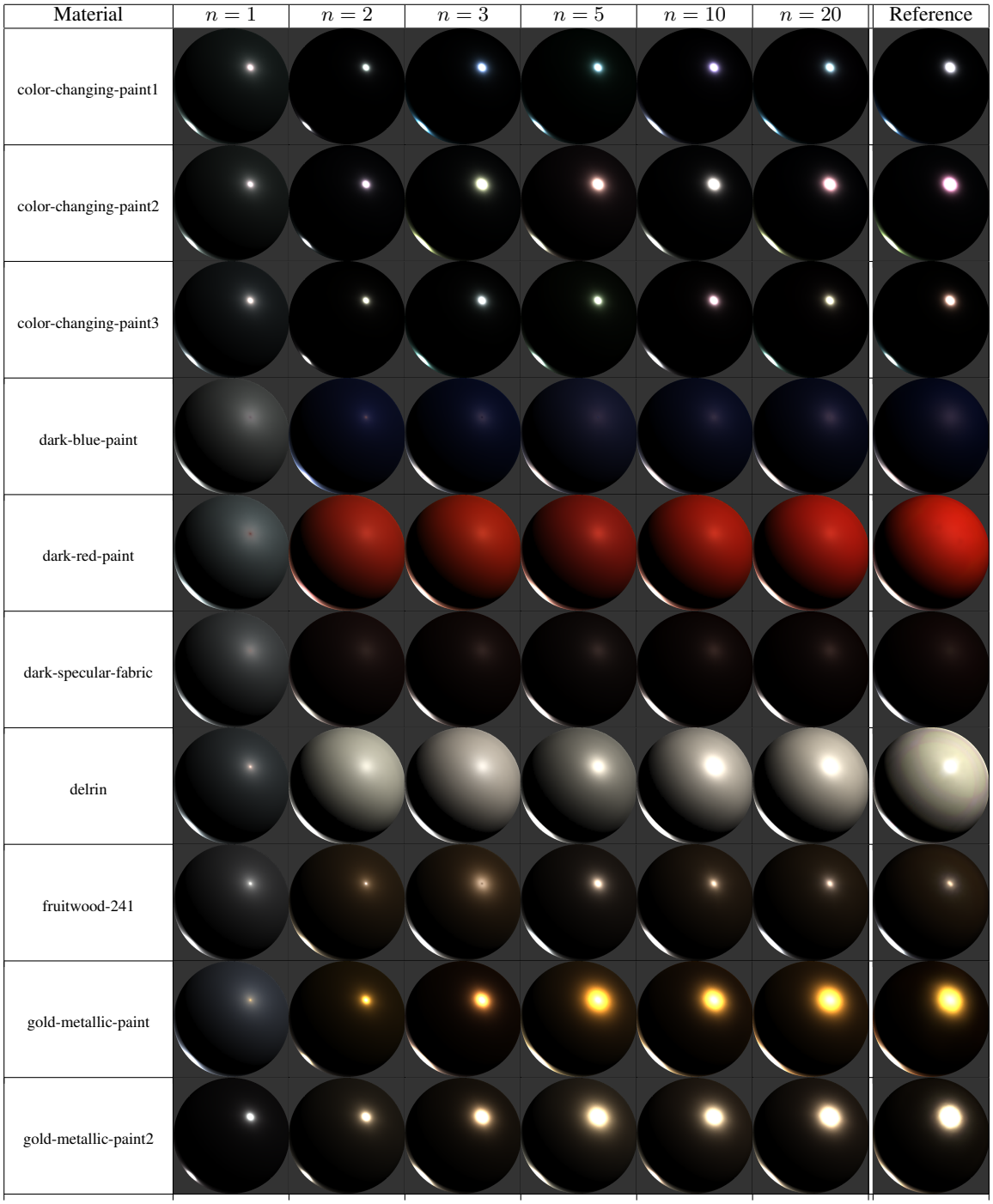

Figure 8: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

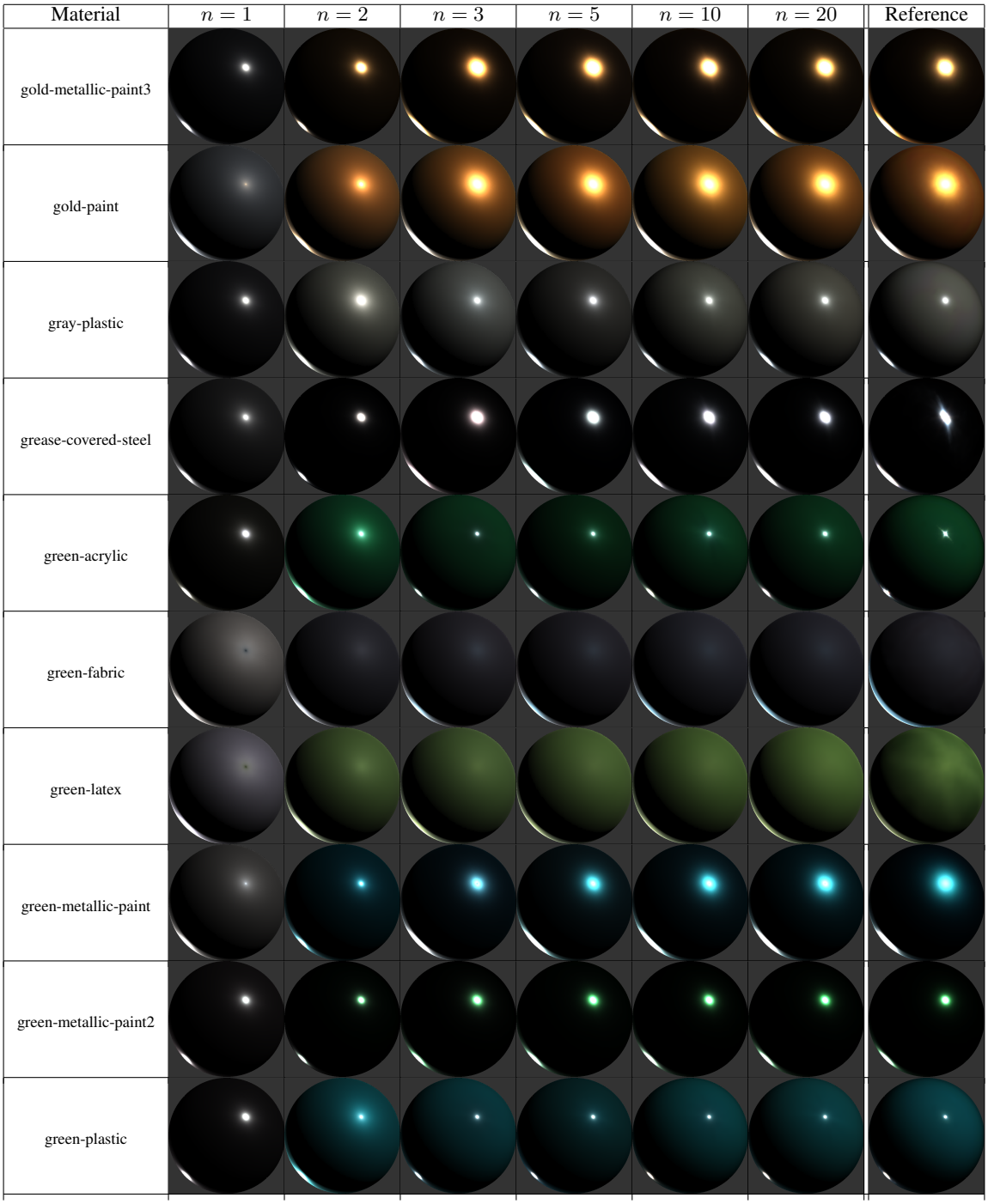

Figure 9: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

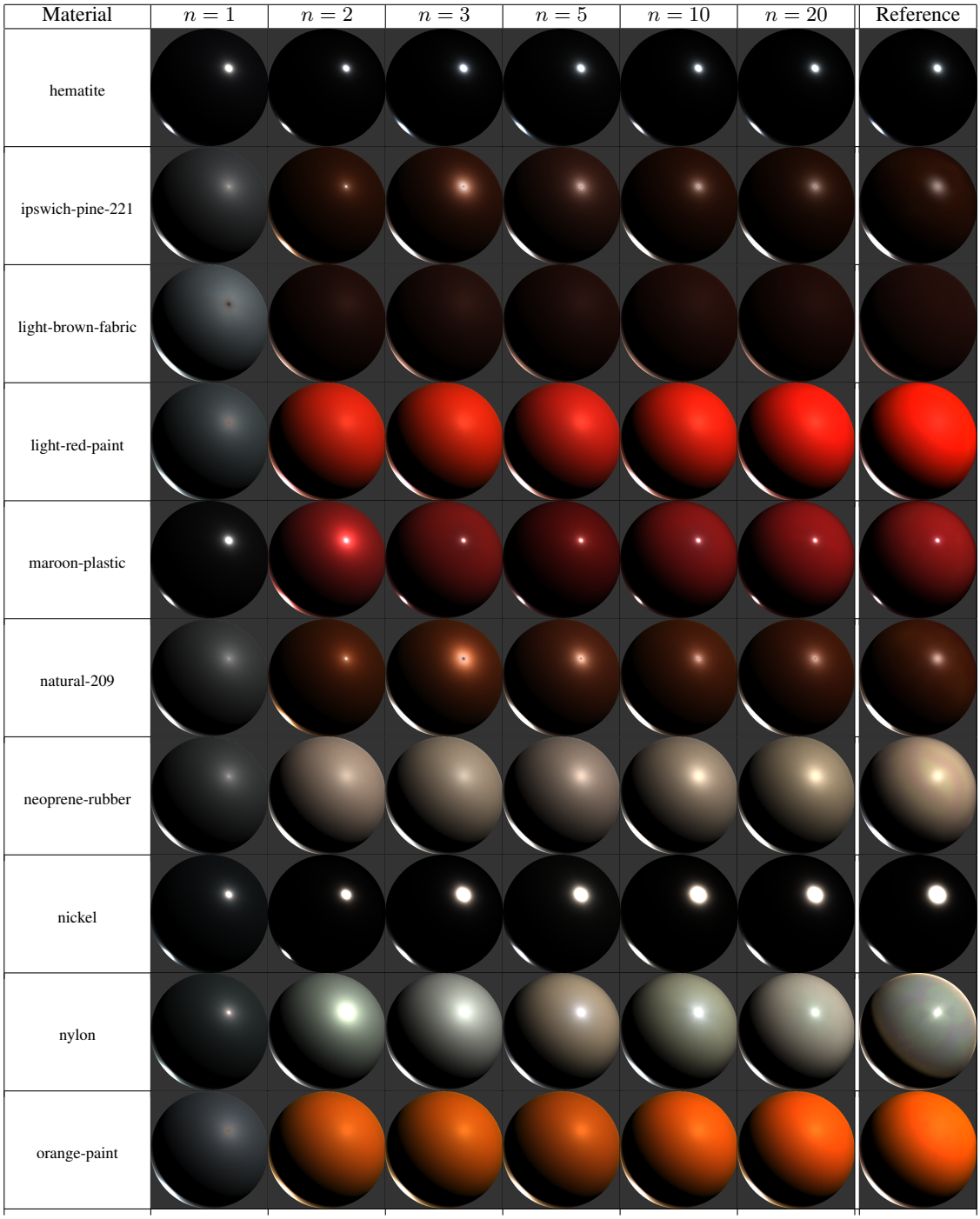

Figure 10: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

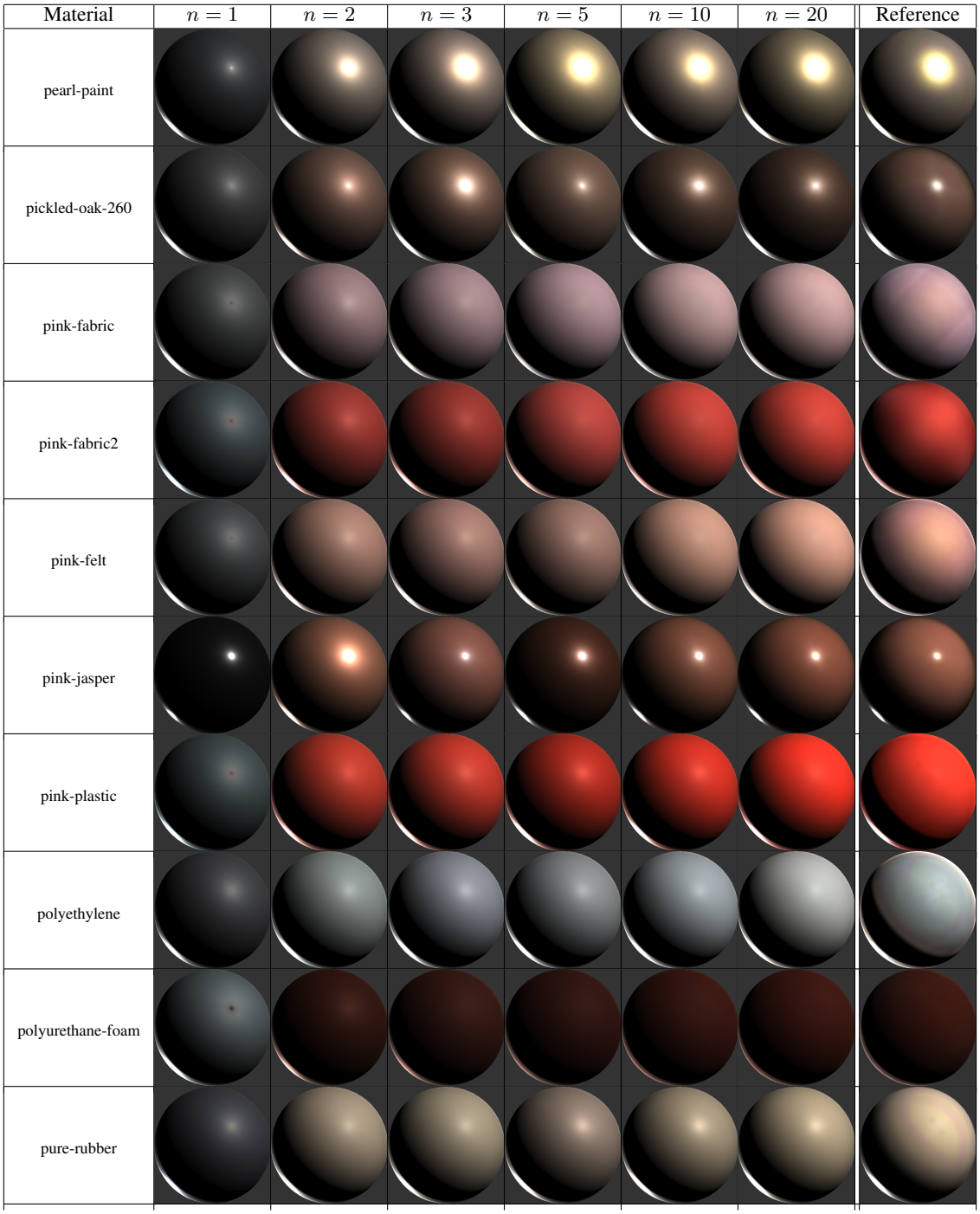

Figure 11: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

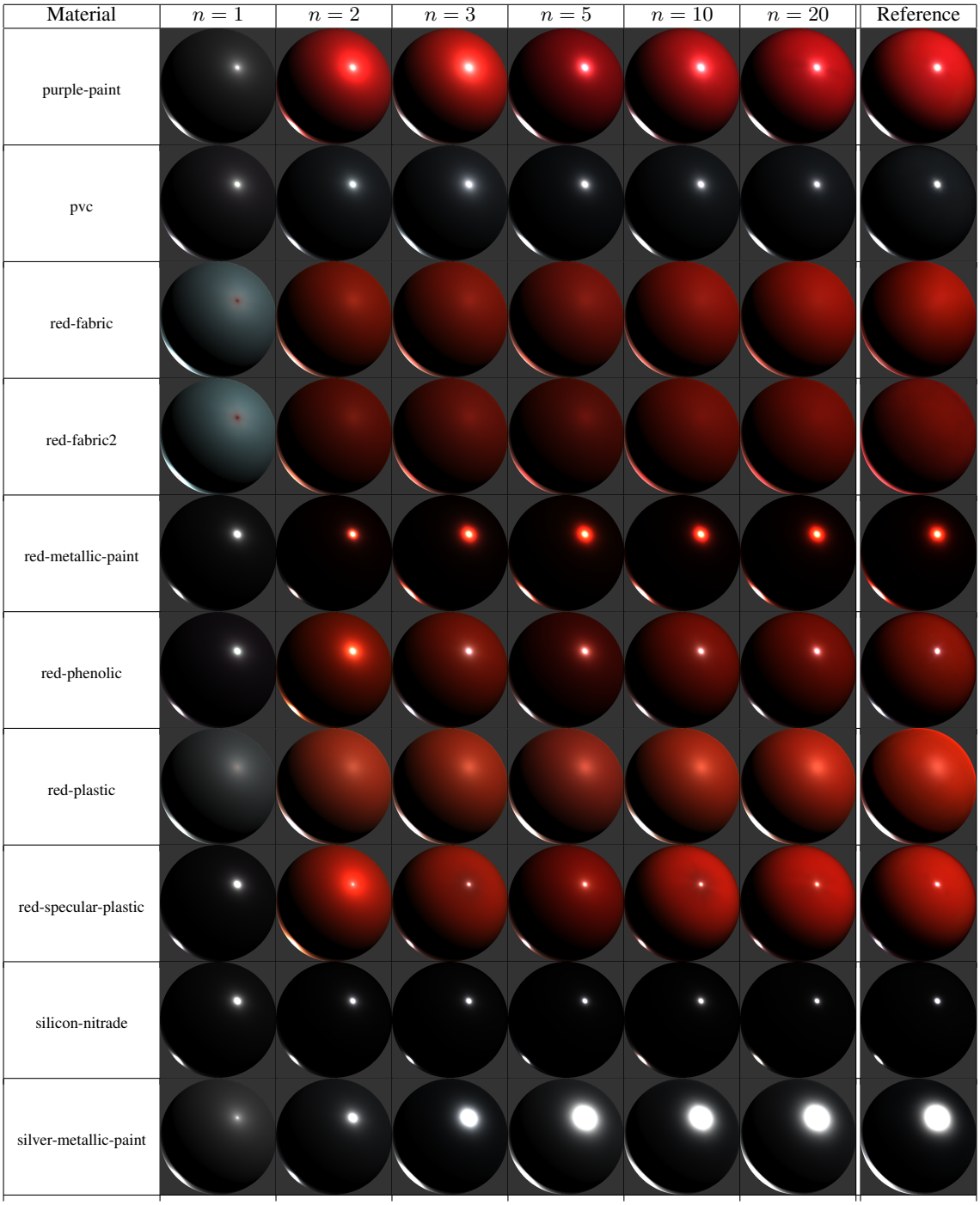

Figure 12: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

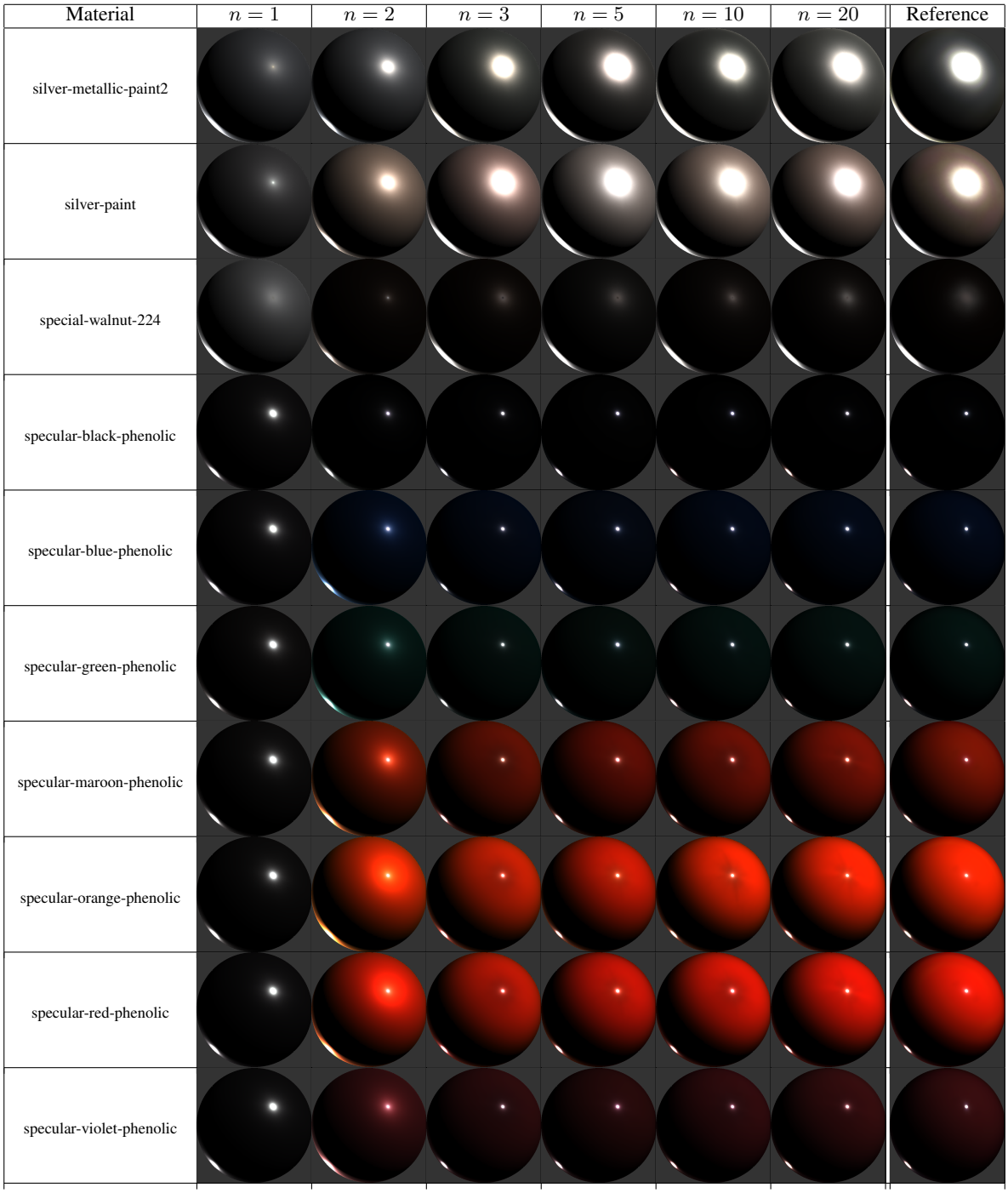

Figure 13: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

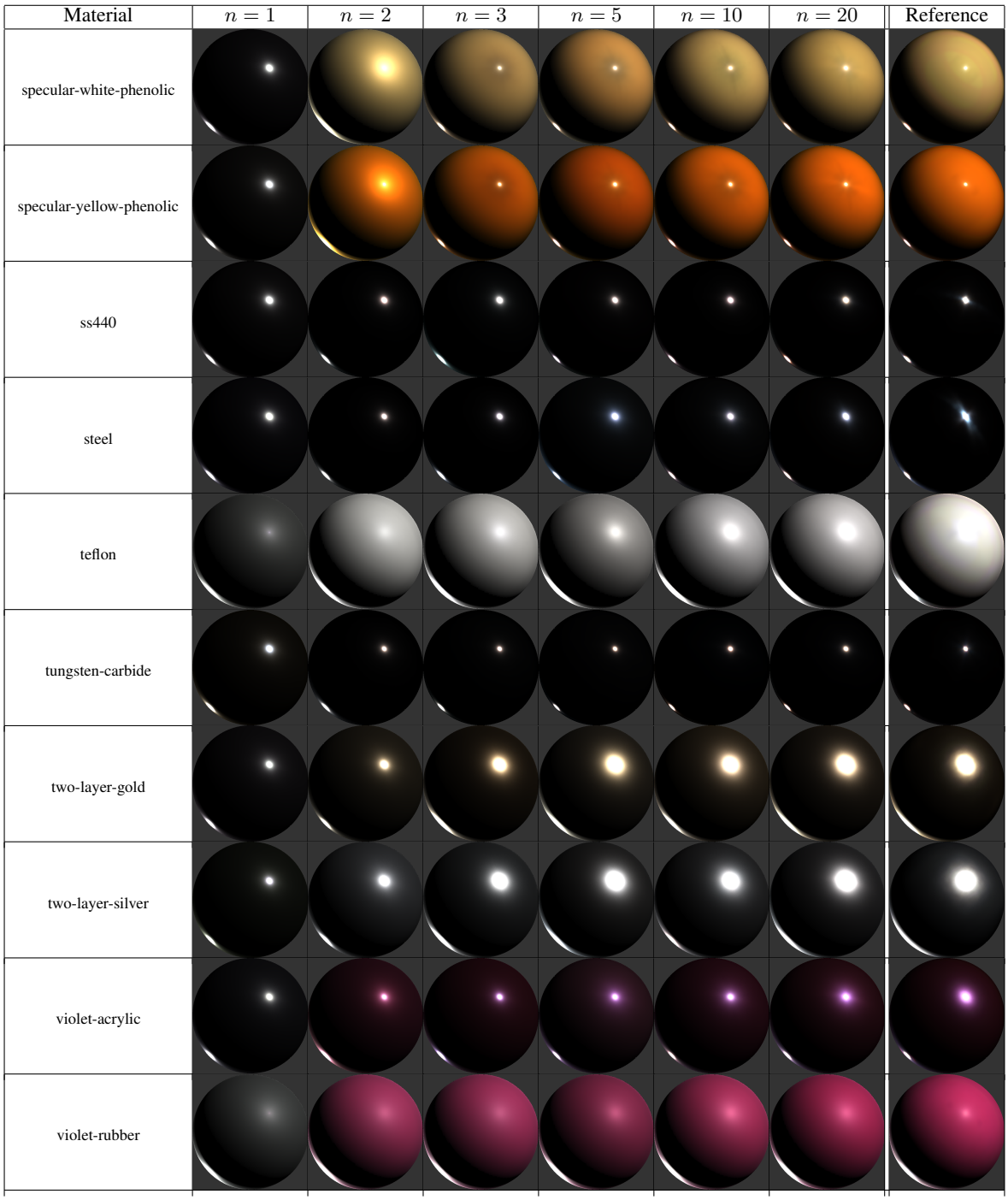

Figure 14: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

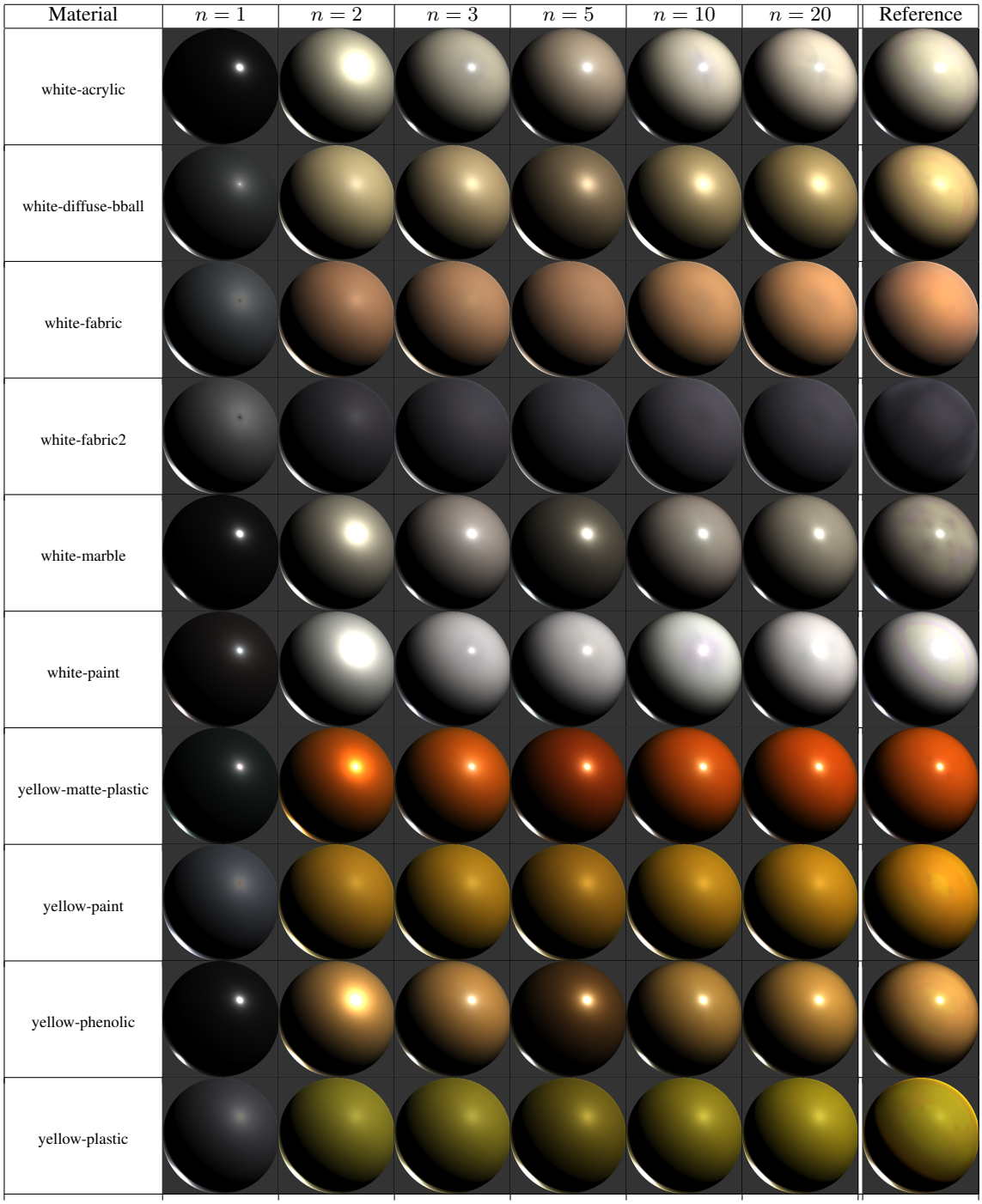

Figure 15: *Reconstructions of MERL BRDF samples. The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. References are shown in the right column*

2.2 Cornell

Reconstructions of Cornell Reflectance Database samples for an increasing number of samples. First figure presents point-sampling. The second figure presents spherical sampling.

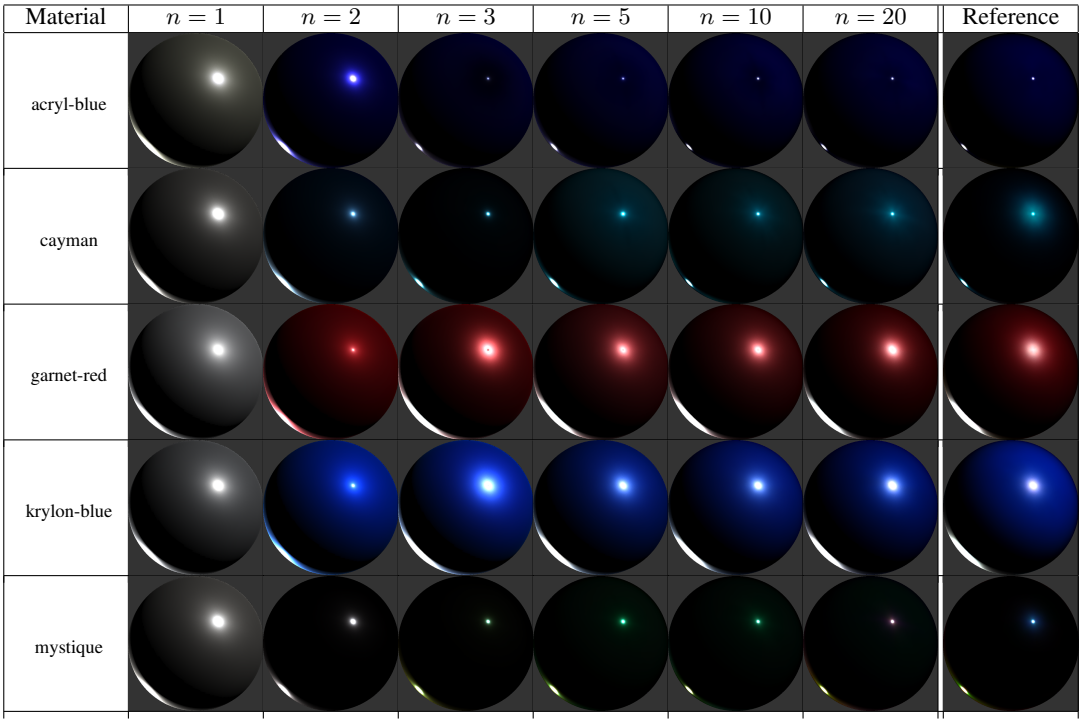

Figure 16: *Reconstructions of unknown samples (10 Cornell Reflectance Database samples not used at all for computing principal components (PCs) and sample directions). The BRDFs are rendered as spheres, illuminated by a front-light at a direction of* $[1, 1, 1]$*, and a back-light causing grazing angle reflections at* $[-1, -1, -3]$*. Reconstructions are made with* $n = \{1, 2, 3, 5, 10, 20\}$ *sampling points. Finally, the far right column shows reference renderings of the true BRDFs. We see that generally 3-10 measurements are sufficient to capture the true appearance of a material. Note that "Cayman" and "Mystique" are complex car-paints and are not fully explained by the number of samples used here.*

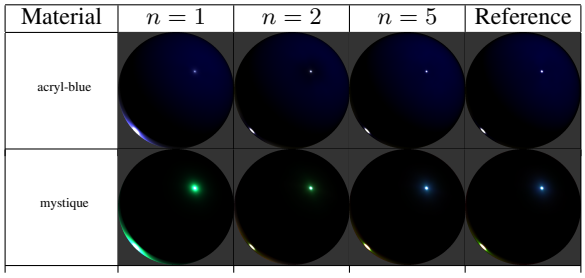

Figure 17: *Reconstructions of Cornell samples not shown in main paper, simulating BRDF capture using a sphere. Note that the complex "Mystique" color-changing properties are correctly captured by 5 images.*