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Focusing light through a free-form scattering medium

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Imaging and transport light through scattering opaque media is a hot topic pursued in multiple fields, ranging from nanotechnology to life sciences. A promising technique to do this is wavefront shaping (WFS), where the light propagation through a scattering medium is controlled by interference [1][2]. Recently, the potential of WFS was even extended to, for instance, time-varying samples [3][4]. In most cases to date, WFS has been done on the quintessential scattering sample geometry, namely in slabs.

Real-world applications, however, require samples to have any shape – "free-form scattering optics" – that defies current theories. Here, we present the study of an opaque sample of TiO2 particles suspended in silicone. Exploiting the flexibility of silicone, we are able to modify the geometry of the sample and measure the enhancement of the intensity η in a point of the speckle pattern. Using this opportunity, we compare the performance of a flat and a free form sample. These experimental measurements will be compared with a newly formulated theory of light transport in free form scattering media.

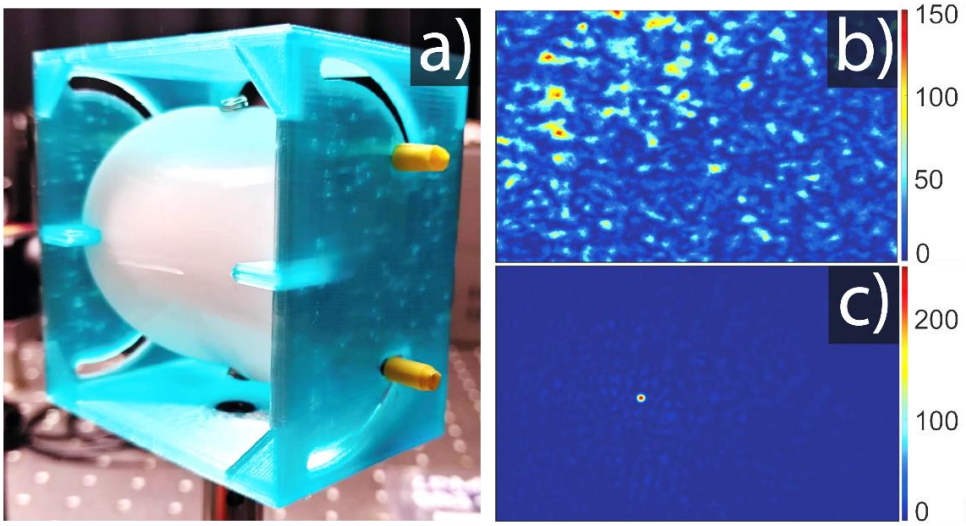

Fig. 1 a) Photo of a free formed (curve) slab, sample of TiO2 nanoparticles in silicone. b) Speckle when illuminating the bent sample with plane waves. c) Wavefront shaping leads to a brighter spot even when transmitted through a free-formed scattering sample.

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