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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.

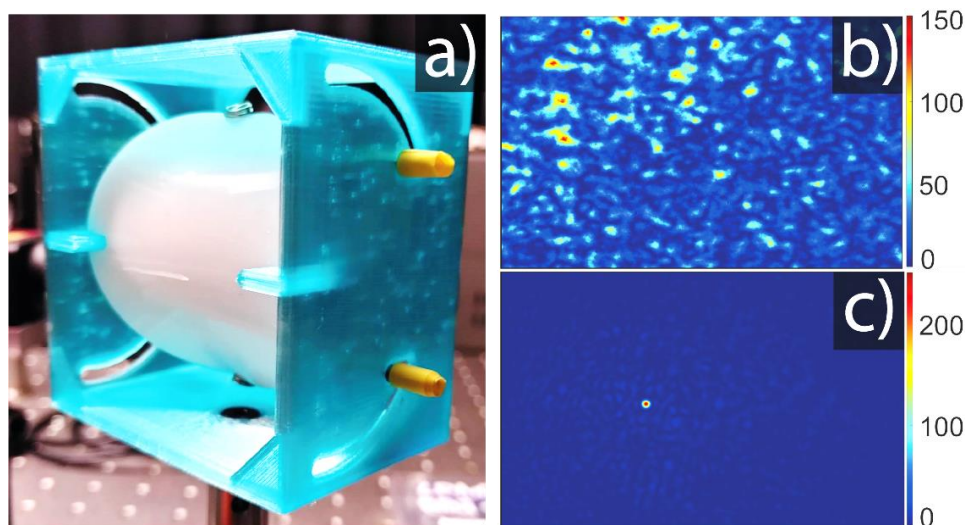


Fig. 1 a) Photo of a free formed (curve) slab, sample of TiO₂ nanoparticles in silicone. b) Speckle when illuminating the bent sample with plane waves. c) Wavefront shaping leads to a brighter spot even when transmitted through a free-formed scattering sample.

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