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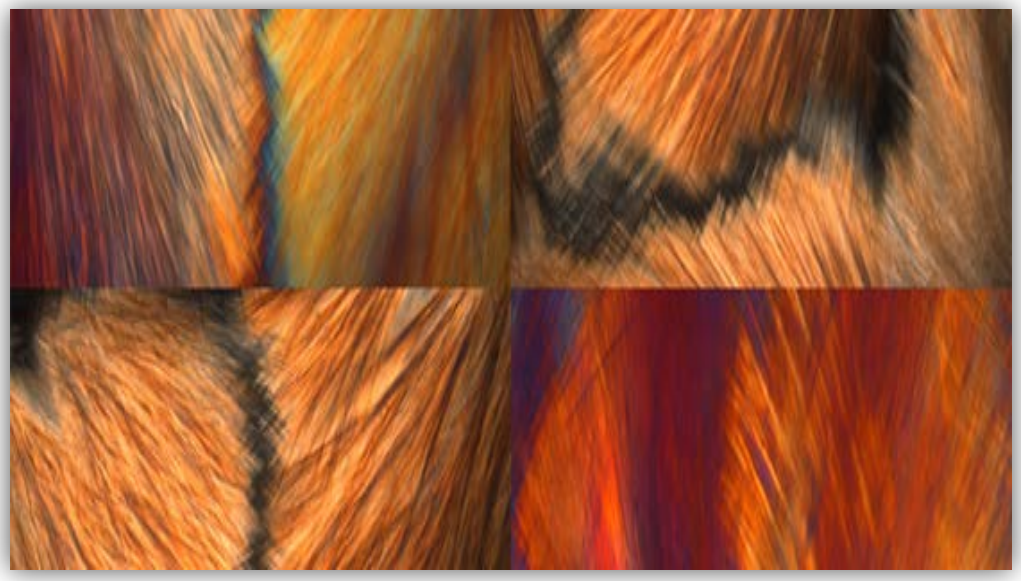
enterprise

Optical Diffuser

Devitrite-based broad-angle light diffuser



A new method for the production of glass optical diffusers, combining low-cost manufacturing and beam shaping capabilities, has been developed by two teams of researchers led by Dr Kevin Knowles from the Department of Materials Science and Metallurgy and Dr Haider Butt of the Centre for Molecular Materials for Photonics and Electronics at the University of Cambridge. Both teams are leading in the research and development of LED technology, combining interdisciplinary expertise in glass and ceramics together with engineering capabilities of optical devices at the nanoscale. It is envisaged that the new type of light diffuser developed at Cambridge will find use in general LED lighting applications in need of high-angle diffusers, where the high cost of holographic diffusers cannot be supported.

Its **key advantages** are:

- broad diffusion - ability to scatter at wide angles
- control over beam shaping
- robust and resistant to high temperatures
- simple manufacturing process
- cheaper to produce than holographic diffusers

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Background

Optical diffusers are used in lighting and optics applications to diffuse light evenly by minimizing or removing bright spots caused by highly localised light sources (such as LEDs). Commercially available optical diffusers, based on the use of ground glass, opals or plastics are associated with one or more of the following disadvantages: small angle diffusion, high scattering losses, brightness reduction and high cost. In particular, ground glass optical diffusers offer a cheap solution with a roughly uniform light distribution, but fail to obtain the high-angle diffusion needed for localised sources. This is instead achieved by holographic diffusers, together with strong beam shaping capabilities, but with the drawback of a high manufacturing cost.

Technology

Researchers at the University of Cambridge have created a novel type of optical diffuser based on glass devitrification, or devitrite, obtained by heat treating commercial soda–lime–silica glass. Devitrite consists of fans of needle-like crystals (see image on the previous page) which can extend up to several millimetres and have interspacing of up to a few hundred nanometres. The randomly oriented fans of devitrite crystals act as highly efficient diffusers for visible light (fig. 1), showing diffusion at high scattering angles, up to 120° (fig. 2 - top) and good performance with low scattering losses over a wide range of wavelengths (fig. 2 - bottom). On top of this, devitrite crystals have the advantage to produce phase modulation of light, due to their high anisotropy. Devitrite diffusers are cheaper to produce than holographic diffusers, but have similar capabilities in terms of broad-angle diffusion and beam shaping, and they can be synthesised in a wide variety of shape and sizes, thus making them an ideal candidate as luminaire diffuser of LED light.

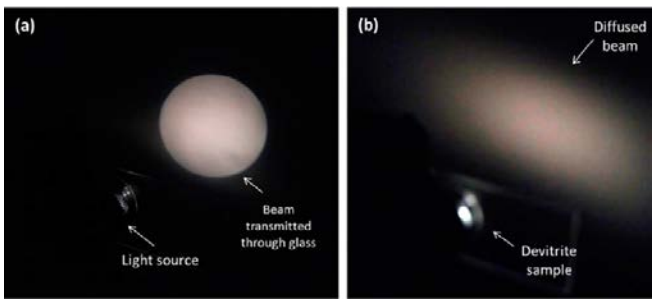

Fig 1 (above). (a) Diverging beam of white light passing through an ordinary soda-lime-silica glass. (b) Same beam after passing through a 30 µm thick sample of devitrite.

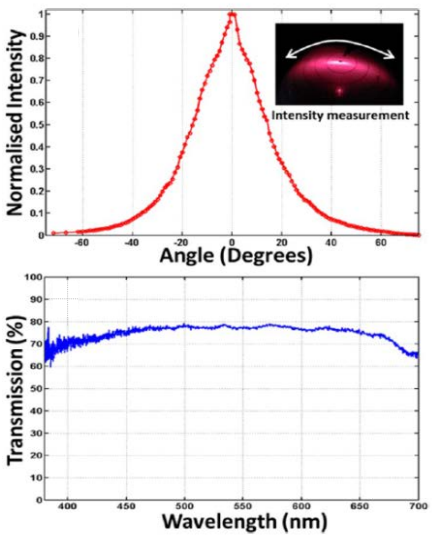

Fig 2 (right). (top) Transmitted light intensity as a function of angle. (bottom) Transmission of visible light measured through a fan of devitrite as a function of wavelength.

Commercialization

We are seeking a commercial partner to collaborate on the development of this technology into a product for the general LED lighting market. The technology is patent pending (PCT application no. PCT/GB2014/052648).