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Highly scattering white cellulose material

Dazzling and natural white colouring solutions

Structural colouration is responsible for many different fade resistant colours found in nature, such as the white *Cyphochilus* beetle (above). Dr Silvia Vignolini and her team in the Department of Chemistry, University of Cambridge and her collaborators at the University of Aalto, have developed a process for producing bright white (highly scattering) films with nano-fibrillated cellulose (also above). This is expected to enable a new generation of pigment-free, biodegradable, white material as a potential replacement for titanium dioxide and zinc oxide. The team is now keen to collaborate with partners to validate this exciting new material. Initial applications include food colouring and cosmetics.

Key Benefits

- The material is biodegradable, ideal for food colouring and cosmetics
- Potential replacement for titanium dioxide, which is being phased out
- Fabricated from a readily available natural material, highly suitable for upscaling
- Completely opaque at tens of microns thick

Dr Silvia Vignolini is a Reader in the Department of Chemistry. She has expertise in materials science and optics, and her research focuses on natural photonic structures for novel colourants.

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What problem does this material solve?

Traditional dyes for use in cosmetics and food have several downsides, such as damaging the environment through using harsh chemicals such as bleach, or having a potentially detrimental effect on human health, either in large amounts or through prolonged use. Titanium dioxide, in particular, has been identified as a possible carcinogen by the UN but is widely used as a white pigment in both the food and cosmetics industry. Preparing white colouring agents from nano-fibrillated cellulose would significantly mitigate the environmental damage done by bleach and eliminate the use of titanium dioxide and also zinc oxide, as cellulose is a readily available natural product. As the white film is biodegradable and processed using relatively benign conditions, it is environmentally friendly (Figure 1).

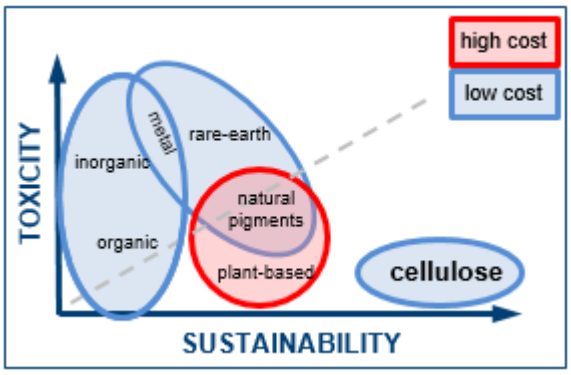

Figure 1: Cellulose Photonic Colourants are Low Cost, Low Toxicity and High Sustainability

Technology

The natural film consists of cellulose nanofibril aerogels. This results in bright white cellulose films that are completely opaque at only a few microns thick, without the need for bleaching agents (Figure 2). The white colourant properties arise from nanoscale random structuring of the fibrils in the film. The team is developing the technology so it can be used in both film and powder form.

Figure 2 – White cellulose films made using the structural colour technology

Applications

Making white films directly is advantageous as they can be produced without the use of bleaching agents, from a natural, biodegradable material. In addition to food additives, their white properties make the films an ideal candidate to replace titanium dioxide and zinc oxide in cosmetics. They may also be adapted for use in new types of environmentally friendly paints.

The researchers have published this work in Advanced Materials: https://onlinelibrary.wiley.com/doi/abs/10.1002/adma.201704050

Benefits of the new pigment-free colourant

In addition to providing significantly improved white colouration and stability, these films also are:

- Biodegradable as they are synthesised from a readily available plant product
- Safe to eat and to be used on the skin in cosmetics
- Very thin films, meaning minimal material use

Next Steps

This technology is protected by a patent application. We are seeking industrial partners to collaborate with us both on production and for specific applications. Please contact us to explore this opportunity.