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Structurally coloured cellulose microparticles

Naturally ingenious materials for brilliant colours

Structural colouration is responsible for many brilliant iridescent colours found in plants, such as the Pollia condensata (above). Dr Silvia Vignolini and her team in the Department of Chemistry, University of Cambridge, have developed a process for producing nanocrystalline cellulose microparticles with structural colouration. This is expected to enable a new generation of pigment-free, biodegradable, natural coloured products. 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, with a range of applications in food colouring, cosmetics, and environmentally friendly paints
- Much more brightly coloured than current non-toxic plant-based dyes
- Fabricated from a readily available natural material, highly suitable for upscaling

Dr Silvia Vignolini is a Lecturer 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 synthetic dyes for use in cosmetics and food have several downsides, such as requiring chemicals from crude oil for synthesis and the potential for damaging the environment. The cosmetics industry in particular is trying to move away from the use of mica, which is often produced in damaging ways. Preparing colouring agents from nanocystalline cellulose would eliminate the requirement for chemicals from crude oil, or mining mica, as cellulose is a readily available natural product. As the micro-particles are biodegradable, they are environmentally friendly (Figure 1).

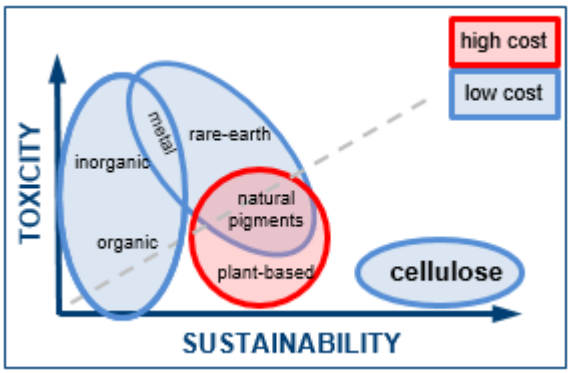

Figure 1: Cellulose Photonic Colourants are Low Cost, Low Toxicity and High Sustainability

Technology

The natural microparticles are synthesised using the self assembly of cellulose nanocrystals (CNCs). Production simply requires an aqueous mixture of off-the-shelf cellulose nanocrystals and a process of forming an emulsion with oil. This results in brightly coloured cellulose micro-particles. The colourant properties then arise from nanoscale ordered structuring of the layers of the particles. The team is developing the upscaling technology for future mass production, which should be compatible with conventional emulsion techniques, such as those used in food production.

Applications

Making microparticles directly is advantageous as the particles have better optical properties than ground-up films e.g. monochromaticity and the colour is not damaged by processing. In addition to food additives, their sparkly properties make them an ideal candidate to replace mica in cosmetics. They may also be adapted for use in new types of environmentally friendly paints.

Benefits of the new pigment-free colourant

In addition to providing significantly improved colour saturation and stability, these micro-particles also:

- Form suspensions in water, enabling low cost environmentally friendly applications
- Are biodegradable as they are synthesised from a readily available plant product
- Are tuneable to a range of colours with or without iridescent properties

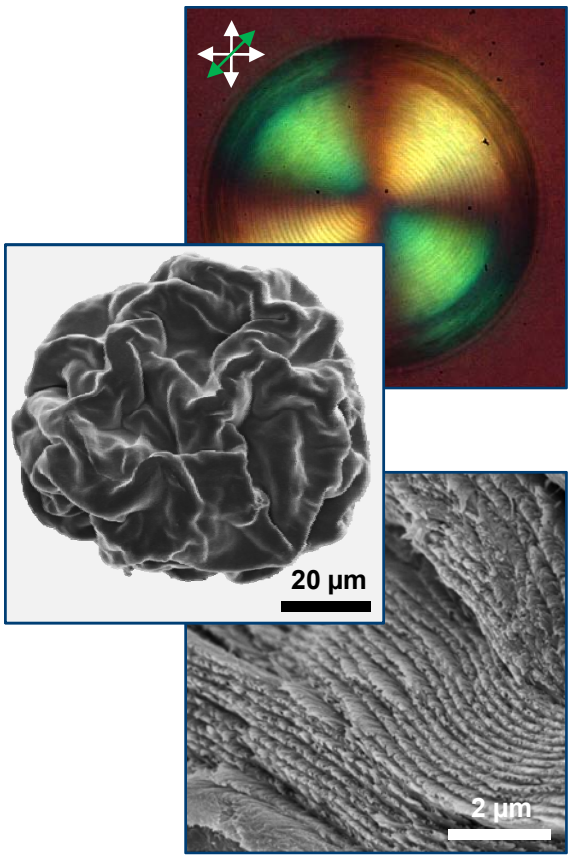

Figure 2: CNCs self-assemble inside aqueous droplets (top) to form cellulose microparticles (middle) with an internal nanostructure order (bottom).

Next steps

This technology is protected by a UK (will be PCT) 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.