Structural colouration is responsible for many of the most brilliant colours found in nature; from iridescent beetles and metallic butterflies to the dazzling tail-feathers of the peacock. Inspired by such natural examples, Dr Silvia Vignolini and her team in the Department of Chemistry, University of Cambridge, have developed a scalable route to structurally-coloured synthetic polymer microparticles. Such pigments could replace existing “interference & effects” pigments, leading to a new generation of colourant products with applications ranging from automotive or architectural paints to anti-counterfeiting or responsive colourants. The team is now keen to collaborate with partners to validate this exciting new material.

**Key Benefits**

- Robust & scalable emulsion-based fabrication.
- Extremely high colour saturation.
- Very wide range of accessible colours, with good colour purity.
- Stable in a broad range of formulations.
- Diverse range of potential applications in paints, inks and coatings, with a choice of iridescent, pearlescent or matte appearance.

**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.

For further information please contact:

Julian Peck
julian.peck@enterprise.cam.ac.uk
+44 (0)1223 330714

Cambridge Enterprise Limited, University of Cambridge
Hauser Forum, 3 Charles Babbage Road, Cambridge CB3 0GTUK
www.enterprise.cam.ac.uk

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What problem does this material solve?
Traditional organic dyes fade over time due to exposure to light, while more fade-resistant mineral dyes are often highly toxic. Commercial ‘interference pigments’, as found in iridescent paints, consist of thin flakes and are commonly made of unsustainable metal oxide-coated mica. Such pigments are limited in terms of the reflected intensity, with the observed colour highly dependent on the orientation. Issues such as the need for a high pigment loading and difficulties in ensuring uniform planar deposition make them a niche and expensive alternative.

Technology. This new polymer-only colourant is comprised of structurally-coloured spherical microparticles that produce vibrant, fade-resistant and non-iridescent colour. The ‘microspheres’ comprise a concentric lamellar arrangement of a ‘bottlebrush block co-polymer’, which itself can be straightforwardly synthesized. By controlling the periodicity of this layered nano-structure the reflected colour is precisely controlled. Under diffuse illumination, e.g. sunlight, the particles appear to be uniformly-coloured, while strong direct illumination, e.g. a car headlamp, can result in angle dependent colour (i.e. iridescence).

Benefits of bottlebrush-based colourants.
- Scalable emulsion-based fabrication.
- The colour is intense, with up to 100% reflectivity from a single ‘microsphere’.
- The colour can be tuned across the entire visible spectrum.
- The colour is stable across a wide range of particle sizes and formulations.
- The colour can be made responsive to external stimuli, for e.g. colorimetric sensors.
- They can be used in coatings, producing iridescent, metallic or matte appearances.

Applications. Synthetic bottlebrush-based colourants offer a robust and scalable alternative to interference-based pigments. Potential applications range from automotive paints and coatings, to optical displays, sensors and security inks.

Next steps. This technology is protected by a GB 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.