New coatings process lowers fuel consumption

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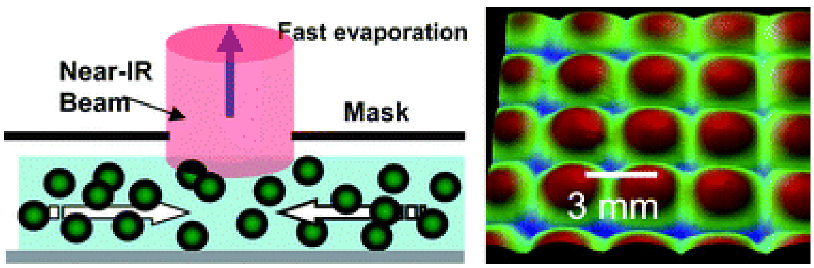

(PhysOrg.com) -- Researchers at the University of Surrey have invented a new process to make bespoke coatings that could one day reduce the 'drag resistance' of ships and aeroplanes and thereby lower fuel consumption.

The coatings have textures that could reduce the carbon footprint of the transport industry by lowering the drag of moving through air or water. In turn, vessels will consume less energy in propulsion.

The team of physicists at the University of Surrey is now collaborating with six companies through funding from an EPSRC Knowledge Transfer Account (KTA). The project is developing ways for industrial manufacturers to use the process to create novel coatings to decorate household goods.

Using their simple, low-cost process, it is possible to create plastic coatings with small bumps and ridges in sizes ranging from less than a millimetre to a couple of centimetres. With the right design, this texture will reduce the drag forces when large vessels pass through air or water.

Professor Joseph Keddie, of the Department of Physics, who led the research, said: “It’s an exciting prospect to have an impact on the energy consumed by planes and ships through a straightforward, inexpensive technology. Our process can create coatings with nearly any desired texture to meet the particular requirements of an application.

“This new technology has grown out of several years of polymer and colloids research within the Soft Matter Physics Group in collaboration with industrial partners. Our KTA project will help to transfer our research ideas into industrial manufacturing.”

There are also other numerous high-tech applications where the University of Surrey’s work can be used, such as to create tiny lenses to focus light. Applications of these “micro lenses” are in digital cameras, photocopiers, and solar cells.

The researchers call their process “infrared radiation-assisted evaporative lithography.” They use beams of infrared light to heat certain spots on wet coatings made of tiny plastic particles in water. The hotter spots evaporate more quickly, and the plastic particles are then guided there as the evaporating water is replaced. The process is simple to use and does not require expensive equipment. The textured coatings can be used to cover nearly any surface.

The research has recently been published, with co-authors at AkzoNobel and at the University of Cambridge, as a cover article in the prestigious Royal Society of Chemistry journal, Soft Matter. The scientists have also filed an international patent application on their process and are looking for partners to apply the new technology in applications.

The coatings can also have an attractive visual appearance and interesting textures, making them exciting for new designs on domestic products.

"Our novel process uses fundamental concepts of science to create objects with tremendous aesthetic appeal. The coatings are beautiful to see," said Dr Argyrios Georgiadis, whose experimental work paved the way for the technology.

More information: Bespoke periodic topography in hard polymer films by infrared radiation-assisted evaporative lithography, *Soft Matter*, 2011, 7, 11098-11102. DOI: 10.1039/C1SM06527K

Abstract
Polymer coatings with periodic topographic patterns, repeating over millimetre length scales, are created from lateral flows in an aqueous dispersion of colloidal particles. The flow is driven by differences in evaporation rate across the wet film surface created by IR radiative heating through a shadow mask. This new process, which we call IR radiation-assisted evaporative lithography (IRAEL), combines IR particle sintering with the concept of evaporative lithography. We show that the height of the surface features increases with an increase in several key parameters: the initial thickness of the film, the volume fraction of particles, and the pitch of the pattern. The results are interpreted by using models of geometry and particle transport. The patterned coatings can function as "paintable" microlens arrays, applicable to nearly any surface. Compared with existing methods for creating textured coatings, IRAEL is simpler, inexpensive, able to create a wide variety of bespoke surfaces, and applicable to nearly any substrate without prior preparation.

Provided by University of Surrey