New composite material that can cool itself down under extreme temperatures

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A cutting-edge material, inspired by nature, that can regulate its own temperature and could equally be used to treat burns and help space capsules withstand atmospheric forces is under development at the University of Nottingham.

The research paper, Temperature—dependent polymer absorber as a switchable state NIR reactor, is published in the journal *Scientific Reports* today (Friday 26 October).

"A major challenge in material science is to work out how to regulate man-made material temperature as the human body can do in relationship to its environment," explains lead author Dr. Mark Alston, Assistant Professor in Environmental Design, from the Faculty of Engineering.

The research used a network of multiple microchannels with active flowing fluids (fluidics) as a method and proof of concept to develop a thermally-functional material made of a synthetic polymer. The material is enhanced with precise control measures that can switch conductive states to manage its own temperature in relationship to its environment.

"This bio-inspired engineering approach advances the structural assembly of polymers for use in advanced materials. Nature uses fluidics to regulate and manage temperature in mammals and in plants to absorb solar radiation though photosynthesis and this research used a leaf-like model to mimic this function in the polymer."

Dr. Alston adds: "This approach will result in an advanced material that can absorb high solar radiation, as the human body can do, to cool itself autonomously whatever the environment it is placed in. A thermally-functional material could be used as a heat regulation system for burn injuries to cool skin surface temperature and monitor and improve healing."

This kind of heat flow management could also prove invaluable in space flight where high solar loads can cause thermal stresses on the structural integrity of space capsules.

By regulation of the structural material temperature of the vehicle, this will not only advance structural properties but could also generate useful power. This thermal energy could be removed from the re-circulated fluid system to be stored in a reservoir tank on board the capsule. Once captured, the energy could be converted into electrical energy or to heat water for use by the crew.

The experimental side of this research is laboratory-based and has been developed in collaboration with UK Government research institute: Scientific Research Facilities Council (SRFC). The next steps for the research are to secure funding for a demonstrator scale-up to present to aerospace manufacturing and to identify an industrial partner.

More information: Mark E. Alston et al, Temperature - dependent polymer absorber as a

switchable state NIR reactor, *Scientific Reports* (2018). DOI: 10.1038/s41598-018-33485-w

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