Metals for a new era

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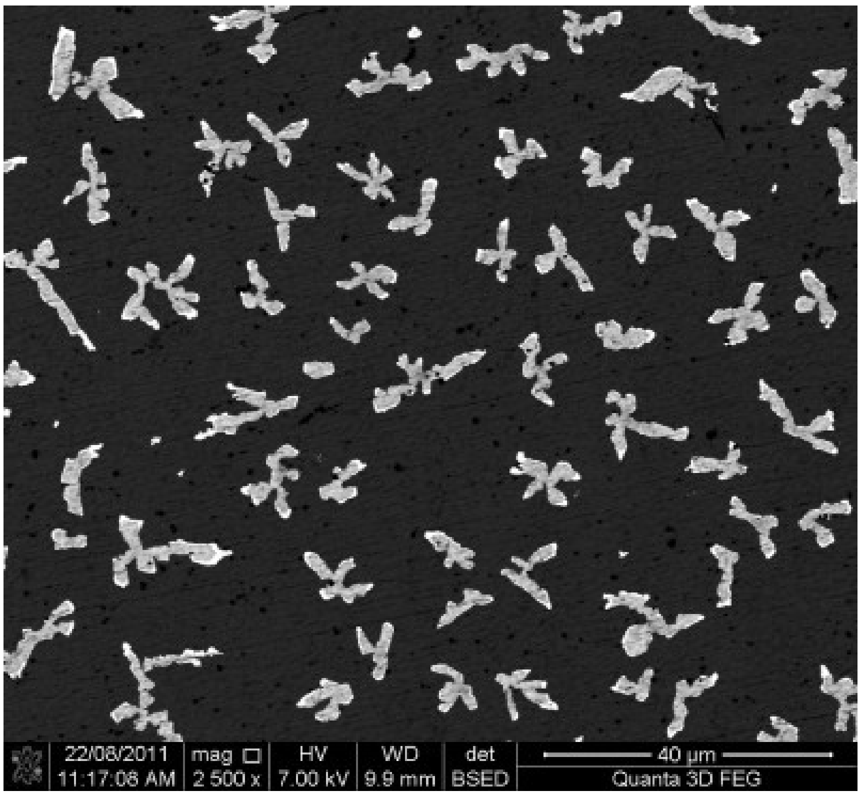

Silicon particles on the surface of an aluminium alloy. Credit: Monash University

Cars that change colour at the push of a button; metals that strengthen with use; buildings that harness energy from the wind... research into designing structural materials that are both responsive and functional is shifting such ideas from the realm of fantasy to reality.

Associate Professor Christopher Hutchinson of the Department of

Materials Engineering at Monash University foresees a future in which reimagined structural materials would have multi-functional roles.

"Instead of designing materials and hoping that their structure and properties do not evolve too much during their life, we should acknowledge that they will evolve in service, and design them so that evolution is forced in a direction that actually improves the properties of the material," Associate Professor Hutchinson said.

The significance of Associate Professor Hutchinson's work on designing materials that dynamically evolve in response to stress is recognised by his Future Fellowship award from the Australian Research Council. He also receives support from the ARC Centre of Excellence for Design in Light Metals.

To create these materials, Associate Professor Hutchinson rearranges atoms in steel or other alloys to make them not only resist stresses that normally degrade the material, but actually improve in response.

Facilities at the Monash Centre for Electron Microscopy, the Australian Synchrotron and the European Synchrotron Radiation Facility in Grenoble, France allow him to monitor the microstructural changes involved.

In practice, such materials would mean that aircraft wings, for example, which currently develop metal fatigue because of constant vibration, would instead grow stronger, remaining safe for much longer.

His success in this process of "redirecting" energy has made Associate Professor Hutchinson consider wider potential for changing structural materials. He and his research team, backed by a Monash Research Accelerator grant, have already worked out ways, using existing manufacturing processes, to cheaply functionalise alloy surfaces.

This work, still at an early stage, opens up a range of possibilities. Alloys that could be made to naturally resist wetting by water would stop plane wings icing up, a major problem in colder countries. Cars could have their colour changed by altering the way the surface reflects light. Ships' hulls could be anti-microbiological, eliminating fouling and improving transport efficiency.

Designing structural materials that can also harness energy is another important focus.

"We put solar cells on the roof: they play no structural role. We should be able to design materials that do both. On a windy day, buildings sway and that energy should be collected," Associate Professor Hutchinson said.

"We're working on ways to cheaply functionalise structural materials so that different forms of energy (mechanical, electromagnetic, etc) can be harvested from them.

"I see a future where there is no difference between functional and structural materials, but we design multi-functional materials that can do both."

Provided by Monash University

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