Superstrong Al alloys may change manufacturing processes for automobiles, aerospace devices

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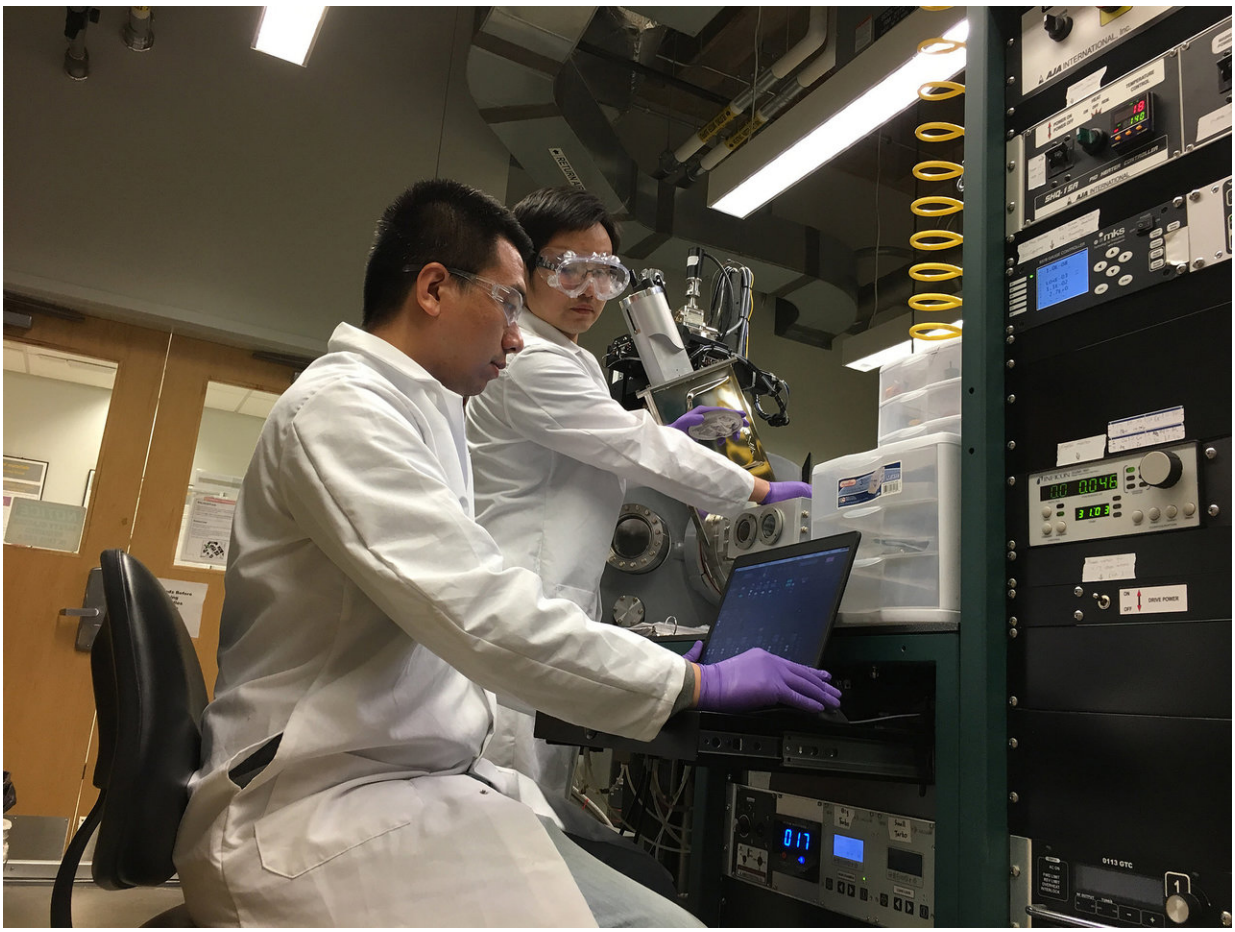

In this photo, Qiang Li makes a deposition program on the operational computer, and Yifan Zhang loads samples into a sputtering chamber to prepare high-strength Al alloy coatings. Credit: Purdue University

Purdue University researchers have developed a superstrong material that may change some manufacturing processes for the aerospace and automobile industries.

The Purdue team, led by Xinghang Zhang, a professor in Purdue's School of Materials Engineering, created high-strength aluminum alloy coatings. According to Zhang, there is an increasing demand for such materials because of their advantages for automakers and aerospace industries.

"We have created a very durable and lightweight aluminum alloy that is just as strong as, and possibly stronger than, stainless steel," Zhang said. "Our aluminum alloy is lightweight and provides flexibility that stainless steel does not in many applications."

Another member of the Purdue team, Yifan Zhang, a graduate student in materials engineering, said the aluminum alloy they created could be used for making wear- and corrosion-resistant automobile parts such as engines and coatings for optical lenses for specialized telescopes in the aerospace industry.

Purdue researchers create the super-strong aluminum alloy by introducing "stacking faults," or distortions in the crystal structure of aluminum. Such distortions can lead to so-called nanotwins and complex stacking faults, such as 9R phase.

"The 9R type of stacking fault is usually rare in aluminum," said Qiang Li, a doctoral student and member of the research team. "We introduce both twin boundaries and 9R phase within nanograins to the lightweight Al alloys that are both strong and highly deformable under stresses. Besides coating applications, we are also looking into scale-up potentials of bulk high-strength Al alloys."

The team also created a way to develop the superstrong alloy coatings by introducing iron or Ti atoms into aluminum's crystal structure. The resulting "nanotwinned" aluminum-iron alloy coatings proved to be one of the strongest aluminum alloys ever created, comparable to high-strength steels. The findings were published recently in *Advanced Materials* and *Scripta Materialia*.

More information: Y.F. Zhang et al. Microstructure and mechanical behavior of nanotwinned AlTi alloys with 9R phase, *Scripta Materialia* (2018). DOI: 10.1016/j.scriptamat.2018.01.010

Qiang Li et al. High-Strength Nanotwinned Al Alloys with 9R Phase, *Advanced Materials* (2018). DOI: 10.1002/adma.201704629

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