

Adding copper strengthens 3-D-printed titanium

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3D-printed titanium-copper bars with titanium powder and copper powder.
Credit: RMIT University

Successful trials of titanium-copper alloys for 3-D printing could kickstart a new range of high-performance alloys for medical device,

defence and aerospace applications.

Current titanium alloys used in additive manufacturing often cool and bond together in column-shaped crystals during the 3-D printing process, making them prone to cracking or distortion.

And unlike aluminium or other commonly used metals, there is no commercial grain refiner for titanium that manufacturers can use to effectively refine the microstructure to avoid these issues.

But now a new titanium alloy with copper, unveiled today in *Nature*, appears to have solved this problem.

Professor Mark Easton from RMIT University's School of Engineering said their titanium-copper alloy printed with "exceptional properties" without any special process control or additional treatment.

"Of particular note was its fully equiaxed grain structure: this means the crystal [grains](#) had grown equally in all directions to form a strong bond, instead of in columns, which can lead to [weak points](#) liable to cracking."

"Alloys with this microstructure can withstand much higher forces and will be much less likely to have defects, such as cracking or distortion, during manufacture," Easton said.



The Trumpf 3D printer used in the experiments at RMIT University's Advanced Manufacturing Precinct. Credit: RMIT University

The collaborative project involved leading researchers in the area of alloy composition and grain microstructure from RMIT University, CSIRO, the University of Queensland and the Ohio State University.

CSIRO Senior Principal Research Scientist, Dr. Mark Gibson, said their findings also suggest similar metal systems could be treated in the same way to improve their properties.

"Titanium-copper alloys are one option, particularly if the use of other additional alloying elements or heat treatments can be employed to improve the properties further," he said.

"But there are also a number of other alloying elements that are likely to have similar effects. These could all have applications in the aerospace and biomedical industries."

Gibson said the new breed of alloys could increase manufacturers' production rates and allow for more complex parts to be manufactured.

"In general, it opens up the possibility of developing a new range of titanium-based [alloys](#) specifically developed for 3-D printing with exceptional properties," he said.

"It has been a delight, as it has been my [good fortune](#) for some time, to work on such an interesting and significant project as this with such a talented band of scientists."

More information: Additive manufacturing of ultrafine-grained high-strength titanium alloys, *Nature* (2019). [DOI: 10.1038/s41586-019-1783-1](#) , [nature.com/articles/s41586-019-1783-1](https://www.nature.com/articles/s41586-019-1783-1)

Provided by RMIT University

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