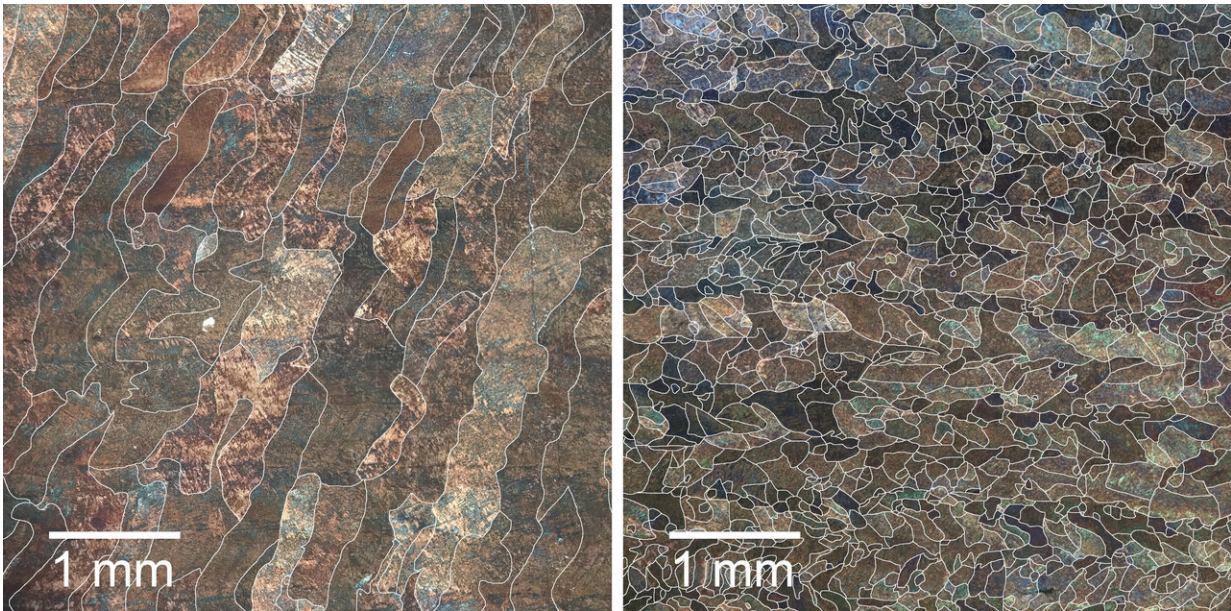


Ultrasound can make stronger 3-D-printed alloys

January 9 2020



3D printed Titanium alloys under an electron microscope: sample on the left with large, elongated crystals was printed conventionally, while sample on the right with finer, shorter crystals was printed sitting on a ultrasonic generator. Credit: RMIT University

Researchers have used sound vibrations to shake metal alloy grains into tighter formation during 3-D printing.

A study just published in *Nature Communications* shows high frequency sound waves can have a significant impact on the inner micro-structure

of 3-D printed [alloys](#), making them more consistent and stronger than those printed conventionally.

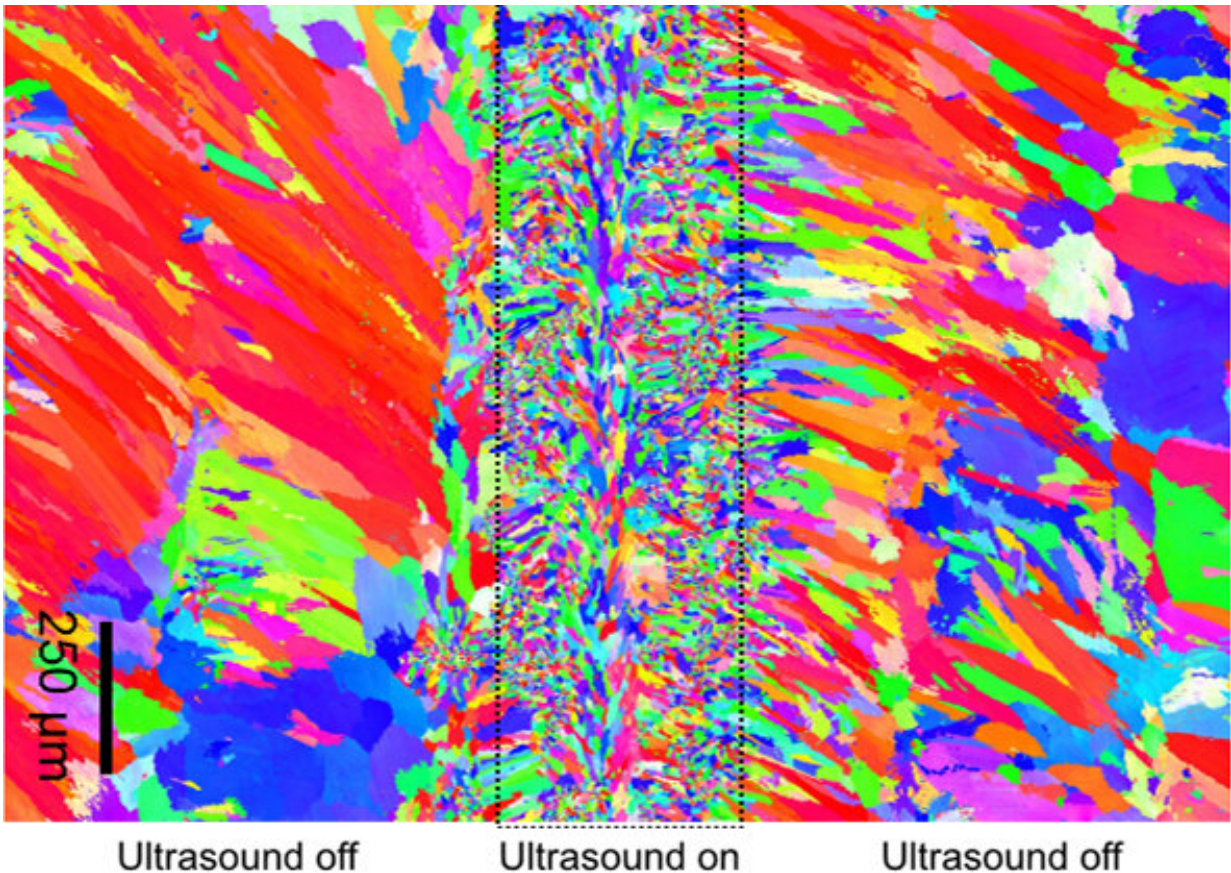
Lead author and Ph.D. candidate from RMIT University's School of Engineering, Carmelo Todaro, said the promising results could inspire new forms of additive manufacturing.

"If you look at the microscopic structure of 3-D printed alloys, they're often made up of large and elongated crystals," Todaro explained.

"This can make them less acceptable for engineering applications due to their lower mechanical performance and increased tendency to crack during [printing](#)."

"But the microscopic structure of the alloys we applied ultrasound to during printing looked markedly different: the alloy crystals were very fine and fully equiaxed, meaning they had formed equally in all directions throughout the entire printed metal part."

Testing showed these parts had a 12% improvement in tensile strength and yield stress compared with those made through conventional additive manufacturing.



Visualisation of grain structure in 3D printed Inconel 625 achieved by turning the ultrasound on and off during printing. Credit: RMIT University

The team demonstrated their ultrasound approach using two major commercial grade alloys: a titanium alloy commonly used for aircraft parts and biomechanical implants, known as Ti-6Al-4V, and a nickel-based superalloy often used in marine and petroleum industries called Inconel 625.

By simply switching the ultrasound generator on and off during printing, the team also showed how specific parts of a 3-D printed object can be made with different microscopic structures and compositions, useful for

what's known as functional grading.

Study co-author and project supervisor, RMIT's Distinguished Professor Ma Qian, said he hoped their promising results would spark interest in specially designed ultrasound devices for metal 3-D printing.

"Although we used a titanium alloy and a nickel-based superalloy, we expect that the method can be applicable to other commercial metals, such as stainless steels, aluminium alloys and cobalt alloys," Qian said.

"We anticipate this technique can be scaled up to enable 3-D printing of most industrially relevant metal alloys for higher performance structural parts or structurally graded alloys."

The article 'Grain structure control during [metal](#) 3D printing by high-intensity ultrasound' is published in *Nature Communications*.

More information: *Nature Communications* (2020). [DOI: 10.1038/s41467-019-13874-z](#)

Provided by RMIT University

Citation: Ultrasound can make stronger 3-D-printed alloys (2020, January 9) retrieved 26 April 2024 from <https://phys.org/news/2020-01-ultrasound-stronger-d-printed-alloys.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.