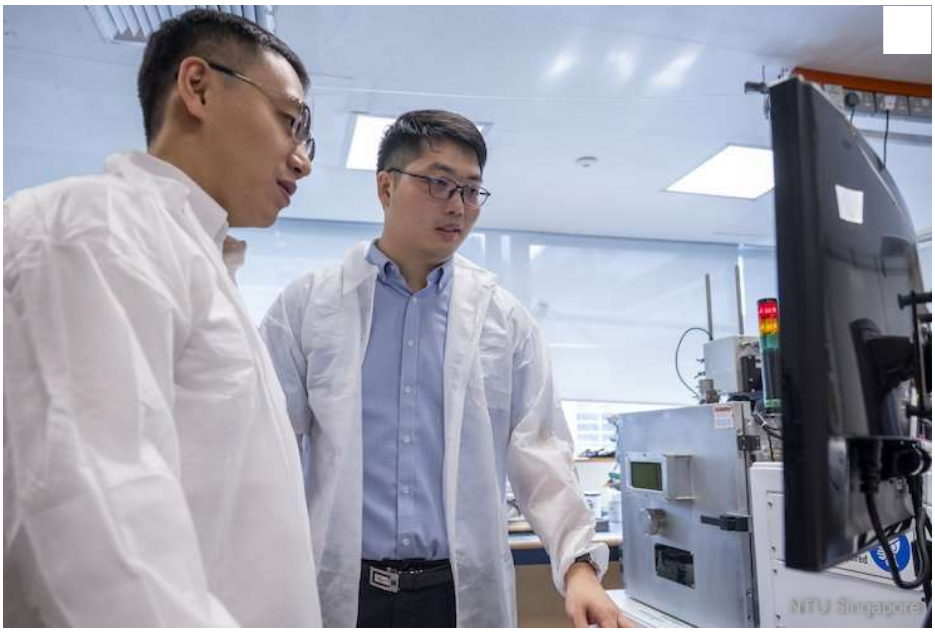
Researchers develop method for producing 3D printed metals with contrasting properties

BY SAM DAVIES 31 OCTOBER 2023 13:39



Dr Gao Shubo (left) and Dr Li Zhi (right) operating a laser powder bed fusion to print components for their research.

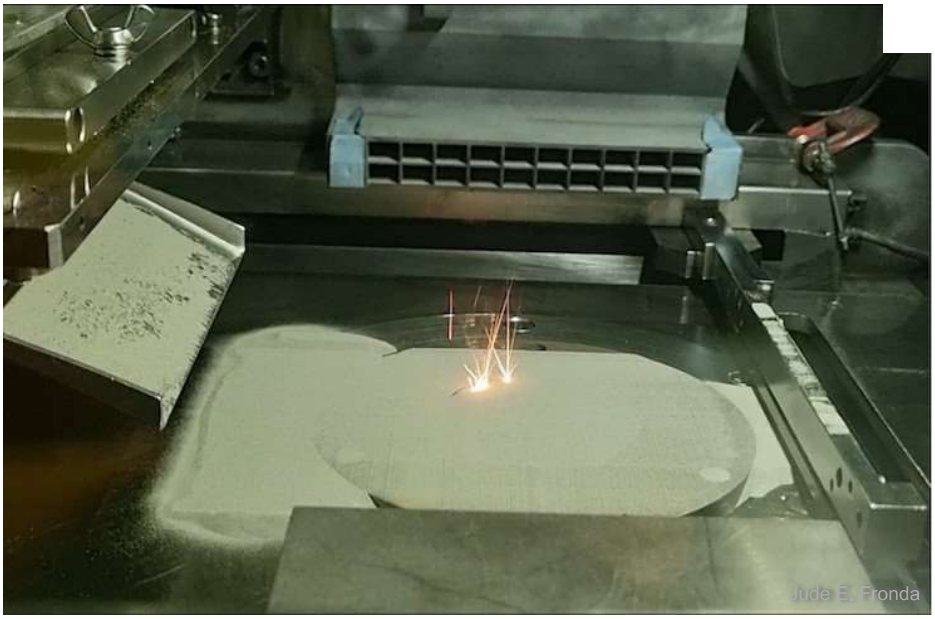
Researchers from Nanyang Technological University Singapore (NTU Singapore) and University of Cambridge have developed a method

for producing 3D printed metals with contrasting properties.

The technique ‘uses 3D printing steps’ to make customised metal parts with different properties, such as having some regions of the metal stronger than others, or having differing levels of corrosion resistance in the same metal.

A team led by Professor Gao Huajian, a University Professor at NTU Singapore, and Assistant Professor Matteo Seita from the University of Cambridge, took inspiration from ‘heating and beating’ methods to develop the new process. With this inspiration, the researchers combined materials science and mechanical engineering principles before applying 3D printing techniques usually used to remove and prevent defects in printed metals to alter microscopic structures in the metals to change their properties. This method is said to allow manufacturers to decide the type of internal microstructure they want and where precisely it can be formed in the metal.

While taking inspiration from heating and beating processes, the aim of the research was to modify the metal’s internal microstructures without beating, since beating can inadvertently harm, for example, the internal structures of 3D printed metals. Dr Gao Shubo, the first author of the research paper published in Nature Communications in October 2023, realised that microstructures of metal could be reconfigured by causing the metal to rapidly expand and shrink as it heats up and cools down in the 3D printing process. This can be done by adjusting a 3D printer’s energy source, with the researchers showing that adjusting the laser changes the type of microstructures that form in the metal after it is heated – one structure that makes the metal stronger and another that makes it mechanically weaker. Printed layers were also remelted to encourage the changes in the metal’s microstructures.



One of the laser powder bed fusion machines used in the experiments by NTU Singapore and the University of Cambridge to 3D-print metals with different properties.

The researchers believe that the synergistic interaction between strong and weak regions in the printed metal points to the potential for stronger and tougher materials to be made, while also producing metals with different functional properties.

“Our method opens the way for designing high-performance metal parts with microstructures that can be fine-tuned to adjust the parts’ mechanical and functional properties, even at specific points, and allowing them to be shaped in complex ways with 3D printing,” commented Prof Gao Huajian.

Dr Gao Shubo added: “Our strategy can target specific sites in the metal, which allows manufacturers to design and create complex microstructures that allow the properties of the metal to be customised to a degree not seen before. For instance, the same metal can have contrasting properties in the same part.”

by Sam Davies

31 OCTOBER 2023 13:39