Measuring the bond strength of thin coatings

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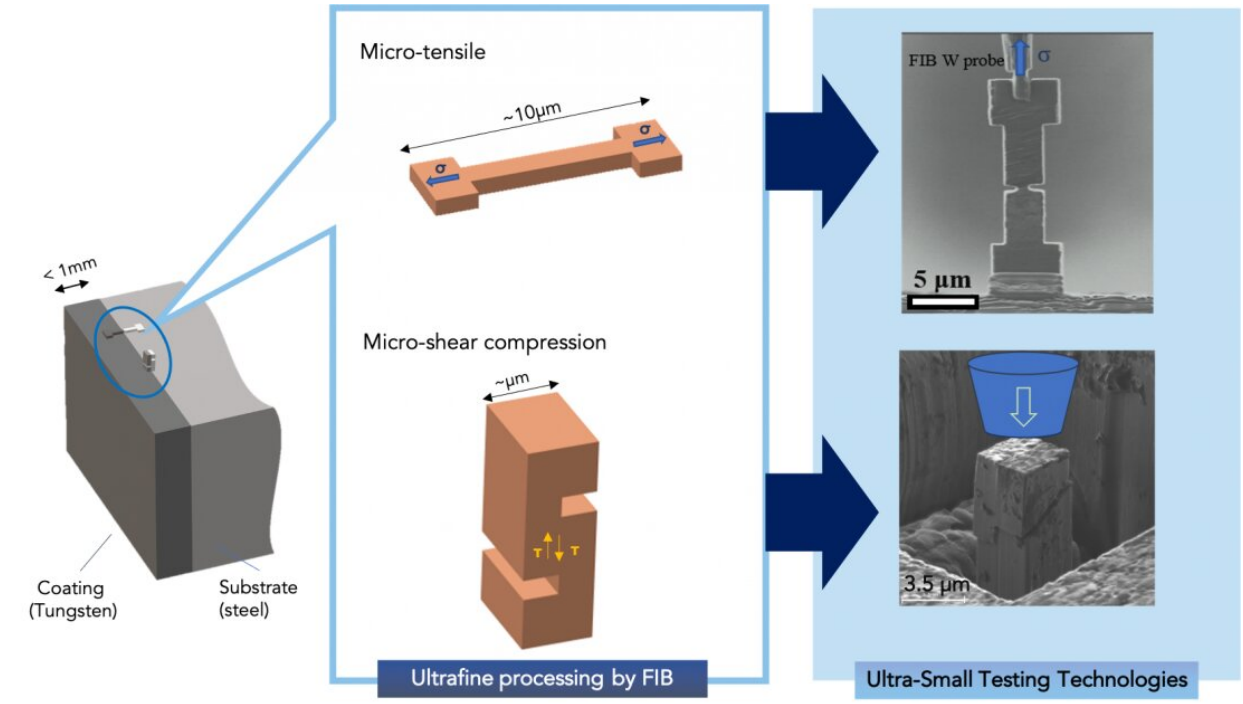

The evaluation flow of direct of interfacial strength by ultra-small testing technology. Credit: Wu Xiangyu

Coating protects structural materials from harsh environments. It is vital for things such as gas turbines, where components can reach high temperatures, or first walls in nuclear fusion reactors. The limited thickness and brittleness of a coating layer, however, make it difficult to measure a coated material's interfacial bonding strength.

Focused ion beam (FIB) and nanoindentation techniques have enabled ultra-small testing technologies (USTT) which evaluate the mechanical properties of small areas. Yet, further research is needed on the applicability of USTTs to measuring dissimilar bonded materials and coating materials.

Now, a research group has employed USTTs to clarify the interfacial bonding strength of 0.2mm tungsten foils coated on ferritic steel. The group, which included Tohoku University's Xiangyu Wu and professor Ryuta Kasada, used micro tensile tests and micro shear compression tests.

Details of their research were published in the journal *Materials Science and Engineering A*.

The group made use of an underwater explosion bonding method developed by one of its members—Kumamoto University's Kazuyuki Hokamoto—to coat a 0.2mm-thick tungsten foil onto ferritic steel. From there, the researchers prepared micrometer-size compressive specimens using FIB. These were then examined by micro shear compression tests to obtain load-displacement curves. When the shear deformation was reduced to 1 μm^2, the shear strength was higher than that of the tungsten coating.

"Our results show the ultra-small specimen's successful measurement of the brittle-tungsten's real interfacial shear strength and steel joint," said Kasada."We hope that USTTs can be applied to measure the bonding strength of various coating materials, contributing to the safe application of multi-material technology used in industrial components."

More information: Xiangyu Wu et al, Bonding strength evaluation of explosive welding joint of tungsten to ferritic steel using ultra-small testing technologies, *Materials Science and Engineering: A* (2021). DOI:

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