Tiny micro pillars hold the key to stronger materials

Dr. Wen Jin Meng, Louisiana State University

Award Title	Louisiana Consortium for Innovation in Manufacturing and Materials (CIMM)
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What is the outcome or accomplishment? (1-2 short sentences describing it and why it is transformative; 50 word max. suggested)*

Louisiana researchers have developed a new testing protocol which uses tiny micro-pillars to measure the critical stress at which tensile interfacial failure occurs, and to gain insight into the physical processes causing the failures. This research yields new science, develops new understanding, and promises new methodologies for the design and implementation of solid interfaces, applicable to a wide range of surface engineering applications.

What is the impact? (1-2 simple sentences describing the benefits for science, industry, society, the economy, national security, *etc.*; suggested 50 word maximum)

Over the last two decades, ceramic coating technology has become an important means to engineer surfaces for manufacturing tools and mechanical components that will have improved wear resistance, longer contact fatigue life, and strong mechanical performance. Understanding of the key physical factors governing solid/solid interfacial mechanical integrity will lead to true materials-based interfacial design and accelerated product development cycles in the U.S. advanced manufacturing industry.

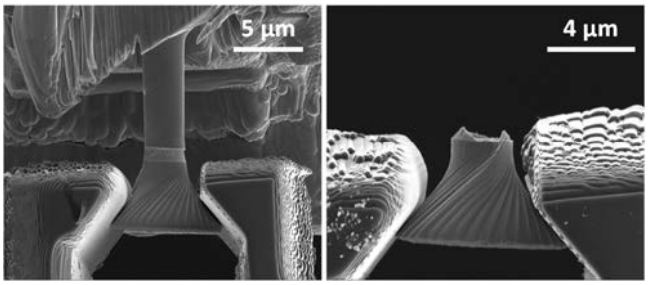
What explanation/background does the lay reader need to understand the significance of this outcome? (1-2 paragraphs that might include, for example, more on who, when, where; NSF's role; support from multiple directorates/offices; what makes this accomplishment unique; additional intellectual merits; or broader impacts such as education, outreach, or infrastructure improvement that are integral to this outcome; suggested 150 word maximum)

At present, experimental protocols for quantitative evaluation of the mechanical integrity of solid/solid interfaces are lacking. Theoretical and numerical models of solid/solid interfaces that take key physical factors into account are likewise missing. Engineering of coating/substrate interfaces proceeds empirically, often involving slow and expensive testing under actual application conditions. To help develop models that can guide and accelerate the development of solid/solid interfaces, a team of researchers led by Drs. Wen Jin Meng and Shuai Shao at Louisiana State University (LSU), in collaboration with Dr. John Hutchinson of Harvard

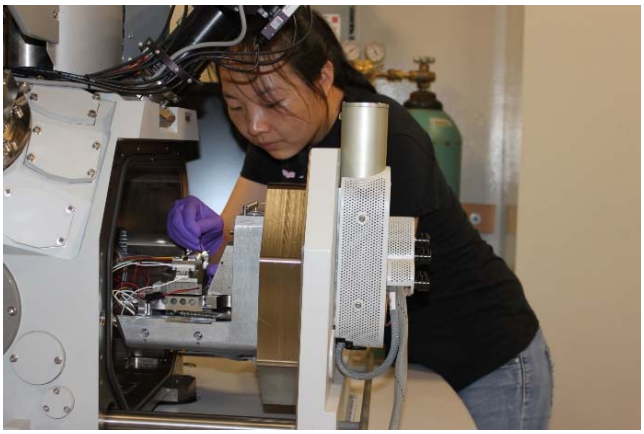
University, performed new measurements on how metal/ceramic interfaces respond to tensile loading.

This is the first time such measurements will have been made. The results of these measurements will feed into the development of theoretical and numerical models for interfacial mechanical integrity.

Photos:



Micro-pillar specimens for measuring critical stress for tensile failure of metal/ceramic interfaces. Five micrometers is about the same size as the diameter of a bacterium. Credit: Dr. Wen Jin Meng, Louisiana State University, wmeng1@lsu.edu.



CIMM researcher in front of a focused ion beam microscope with nano-machining capabilities. Pictured: Louisiana State University graduate student Ms. Xiaoman Zhang. Credit: Dr. Wen Jin Meng, Louisiana State University, wmeng1@lsu.edu.