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Machine learning for next-generation additively manufactured structural alloys in extreme environments

ABSTRACT

The properties and processability of metals govern the design and performance of structural components in our cars, aircraft, and buildings. The advent of additive manufacturing (AM) with new processing conditions and a potential ability to tailor the alloy composition and microstructure at the voxel size resolution has opened novel routes for alloy design to achieve unprecedented properties. However, exploiting all these benefits requires transformation of design concepts and development of new numerical tools tailored to AM. In this talk, I will present how, by benefiting from rapid solidification and local melting in AM and combining ICME techniques and machine learning (ML) tools, we designed a record high-strength, high-temperature creep-resistant printable Al alloy that outperforms conventionally processed alternatives. I will show how the proposed hybrid frameworks offer new perspectives for the discovery of next-generation structural metallic materials to significantly transform industrial applications ranging from aerospace, construction, infrastructure, automotive, and energy sectors to microelectronic devices and biomedical implants.

BIOGRAPHY

S. Mohadeseh Taheri-Mousavi joined CMU as an assistant professor in September 2022 from MIT where she was a postdoctoral associate jointly in the Departments of Mechanical Engineering and Materials Science and Engineering. Before that, she was a postdoctoral fellow at Brown University. She received her Ph.D. from EPFL, Switzerland, and her B.Sc. and M.Sc. from Sharif University of Technology, Iran. She received both early and advanced prestigious Swiss National Science Foundation fellowships for her postdoctoral studies at Brown and MIT. The Taheri-Mousavi Group develops novel multi-scale numerical and analytical frameworks in combination with machine learning techniques to discover next-generation structural alloys produced by various manufacturing techniques (particularly additive manufacturing) and under extreme environmental conditions. Our materials informatics frameworks also guide experiments to be performed efficiently and in a smart manner.

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