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ICME-guided design of novel dispersoid strengthened alloys for additive manufacturing

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Towards the development of high-performance alloys with superior properties (strength and creep), dispersoid-strengthened (DS) alloys manufactured via additive manufacturing (AM) present a promising opportunity for design of high-performance components (e.g. gas burner heads). Challenges arise in alloys not designed for AM due to complex laser-material interactions. Hence, the integration of multi-scale multi-physics experimental and computational methods, i.e., integrated computational materials engineering (ICME), in alloy design for AM is a promising approach to address this issue. This presentation emphasizes the use of an ICME framework to accelerate the development of DS alloys, focusing on process-structure-properties-performance relationships through a synergistic integration of various computational tools, including finite-element models, CALPHAD simulations, phase-field modelling, and further numerical simulations. The culmination of these efforts led to the successful design of a novel alloy, which was subsequently produced using AM. The experimental creep results demonstrated an impressive tenfold decrease in the creep strain rate and 500% increase in the creep life compared to the base alloy.

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