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Abstract

High-entropy alloys with ultra-high strength and large deformability

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High-entropy alloys (HEAs) is a class of materials comprising at least four elements in relatively high concentrations (5–35 at.%) [1]. HEAs were initially proposed for achieving single-phase solid solutions in multi-component alloys, through increasing the configurational entropy of mixing and hindering the formation of intermetallic compounds [2]. In a later stage, metastable and multi-phase HEAs [3,4] have been developed, which have attracted tremendous interests. This talk summarizes the recent experimental studies of HEAs revealing amorphous-crystalline dual-phase nanocomposite structure [5]. The CoCrNi-Fe-Si-B HEA, fabricated using magnetron sputtering, comprises ~8 nm-wide face-centered cubic (fcc) nanocrystals surrounded by ~1 nm-wide amorphous phase. This structure enables a near-theoretical yield strength ($G/24$, where G is the shear modulus of a material) and homogeneous plastic strain above 45%, probed in micropillar compression. This talk also demonstrates one possible application of the novel alloy films as coatings for bulk alloys, as the strong and deformable coatings can inhibit the crack propagation from the bulk alloy, promoting a high ductility [6]. The hybrid nanostructure design provides a general route to achieve high strength and large ductility.

References:

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Short Bio

Dr. Chang Liu worked as a doctoral (2012 – 2017) and postdoctoral (2017 – 2019) scientist in Mechanical and Biomedical Engineering at the City University of Hong Kong. She joined the Max-Planck-Institut für Eisenforschung (MPIE) in 2019. Dr. Liu is the project leader in MPIE for European Union's Horizon 2020 research and innovation programme: “Development of novel and cost-effective coatings for high-energy processing applications (FORGE)”, and the topical leader in MPIE for “Nanostructured alloys for biomedical systems”. Her research interests include high-entropy alloys, metallic glasses and nanostructured alloys for biomedical systems. She has published papers in *Nature Commun.*, *Adv. Mater.*, *Adv. Sci.*, etc, referring to her ResearchGate: <https://www.rese>