

Using a typically brittle structure to toughen nanocrystalline metals

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Nanocrystalline metals are very strong but generally suffer from poor ductility and toughness, limiting their usage as structural materials. In this talk, we explore the usage of distinct grain boundary states, termed “complexions,” in nanostructured metal alloys, with a focus on how these features can be used to solve the long-standing challenge of brittle mechanical response. Unique to this concept is the usage of an amorphous metallic structure which is typically extremely brittle by itself to induce a toughening effect. This success is built on a critical analysis of nanocrystalline and metallic glass deformation physics, to create a unique materials design strategy. As a whole, this work lays the foundation for the engineering of defect structure to design better nanostructured materials.