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Guiding Nanoscale Crystallization of Amorphous Solids

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Converting materials from an amorphous, disordered state to an ordered, crystalline state by heating them to allow atoms to move is a complicated process. Wisconsin MRSEC researchers have found that it depends the atomic arrangements at the boundary between the amorphous and crystal materials and inside the amorphous material, and on the overall size of the sample. These phenomena are illustrated at right for aluminum oxide, Al_2O_3. Al_2O_3 can form two ordered crystal structures, labeled α and γ. Normally, a pre-existing α crystal would lead to more α crystal, but the complex interplay of atomic arrangements in the amorphous layer and at the boundary can create γ crystal instead.

MRSEC researchers have found similar phenomena in systems as diverse as amorphous water (the glassy form of ice) and chalcogenides. These various materials have applications spanning electronics, catalysis, and medicine, so the discovery of common features in their crystallization has potential impact far beyond the IRG's original work in metal oxides.