

UW-Madison: Understanding ceramic 'mortar' of materials may reveal ways to improve them

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MADISON - When most people think of ceramics, they might envision their favorite mug or a flowerpot. But modern technology is full of advanced ceramics, from silicon solar panels to ceramic superconductors and biomedical implants.

Many of those advanced polycrystalline ceramics are combinations of crystalline grains which, at the microscopic level, resemble a stone fence held together with limestone mortar. Like that fence, the strength of the ceramic is determined by the strength of the mortar - which in ceramics is the grain boundary, or the areas where the different grains meet.

Previously, most researchers believed the chemistry of these grain boundaries in ceramics was very stable. But a new study by materials science engineers at the University of Wisconsin-Madison shows that's not the case. In fact, in the important ceramic material silicon carbide, carbon atoms collect at those grain boundaries when the material is exposed to radiation. The finding could help engineers better understand the properties of ceramics and could aid in fine-tuning a new generation of ceramic materials.

The details of the study appear today in the journal Nature Materials.

Since the 1970s, researchers have been aware of similar radiation-induced segregation in metal alloys. Because metal atoms share electrons freely, they are able to mix and unmix easily. When they are bombarded by ion radiation, some of the atoms in the metals will pop out of place and move toward the grain boundaries, and if different types of atoms move at different rates, the chemistry of

the alloy can be altered.

Atoms in ceramics are very selective about which neighbors they bond with and the bonds are much stronger than in metals. That's why researchers believed these atoms weren't subject to the same type of segregation. But when Izabela Szlufarska, a professor of materials science and engineering at UW-Madison, began looking closely at the grain boundaries of silicon carbide, that's not what she found.

STORY CONTINUES AT <https://news.wisc.edu/understanding-ceramic-mortar-of--materials-may-reveal-ways-to-improve-them/>