Advancing brazing alloys

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MSU Engineering seeks new brazing alloys for Solid Oxide Fuel Cells with help from $694,000 grant

Solid Oxide Fuel Cells (SOFCs) are a promising green energy technology offering high efficiencies in chemical-to-electricity conversion, the ability to both store and produce energy, and a possible path to transition from today's hydrocarbon-based economy to a CO2-neutral economy running on hydrogen or biofuels.

First, however, SOFC researchers have to tackle one of its greatest commercialization obstacles – a lack of durable, impermeable sealing materials to hold it all together.

A new $694,000 grant from the U.S. Department of Energy to the Michigan State University College of Engineering will help advance the green technology of SOFCs by designing new SOFC brazing alloys.

Brazing is a metal-joining process similar to soldering, except the temperatures used to melt the filler metal are higher for brazing.

“We hope to design and test new SOFC-compatible, self-passivating brazes that are durable and impermeable to oxygen and hydrogen,” said Jason Nicholas, assistant professor of chemical engineering and materials science. “Our goal is to create brazed solid oxide fuel cells that can withstand both 40,000 hours of operation at 750°C and rapid thermal cycling between 750°C and room temperature.”

“We'll be engineering this fuel cell braze from the ground up,” said Yue Qi, associate professor of chemical engineering and materials science. “We plan to use integrated computational materials engineering strategies to develop new brazes, where alloy design is conducted using computational approaches to identify promising compositions.”

Thomas Bieler, professor of chemical engineering and materials science added, “Experiments with identified alloys will provide input to improve computational models, and will lead to fine tuning. Aging of brazed joints will provide information about evolution of micro-structures that affect long term reliability, and provide additional input for optimizing the braze composition.”

“The new brazes will solve the long-term metal braze degradation issues encountered with traditional silver-based SOFC brazes,” Nicholas added. “They will extend the lifetime of Solid Oxide Fuel Cells, and reduce materials costs by reducing the need for precious metals like silver.”
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