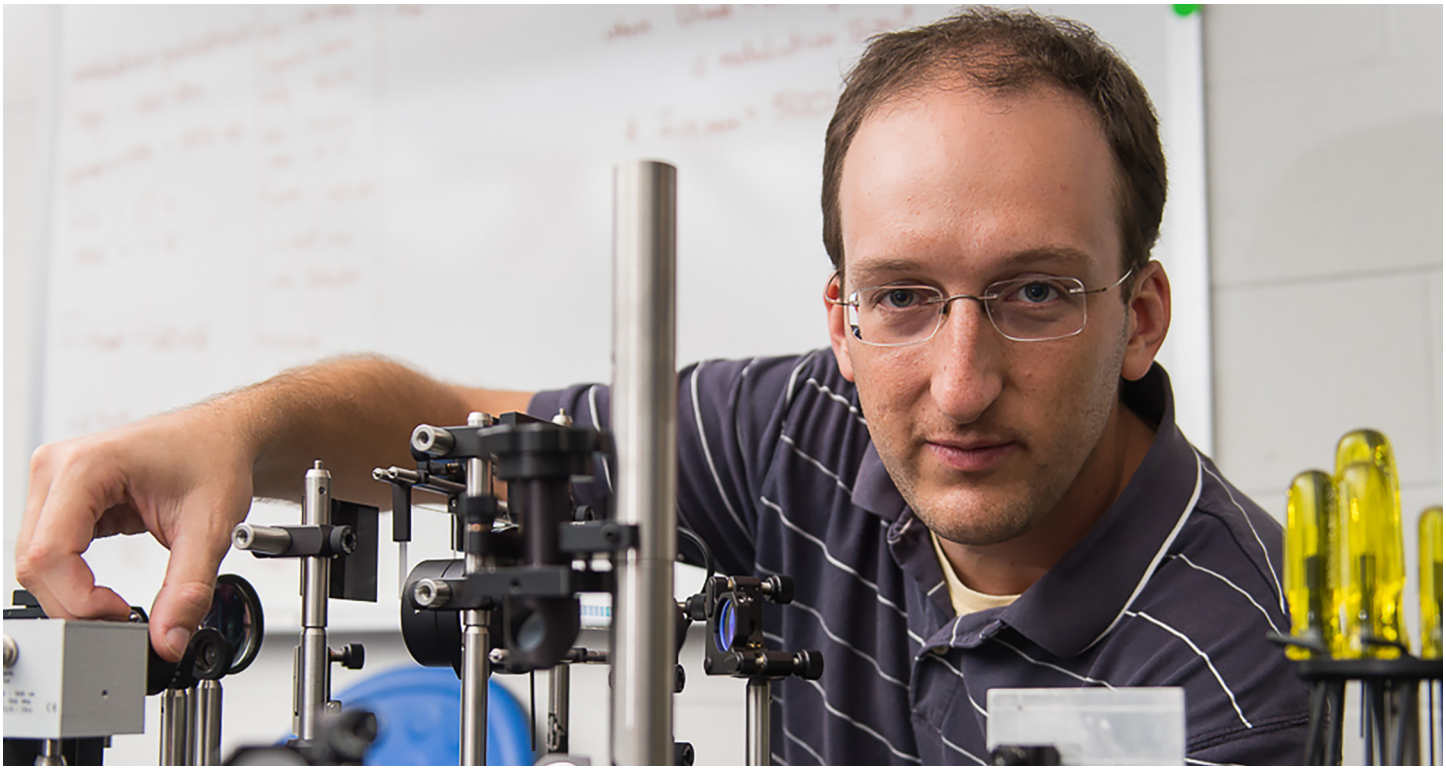
Michael Short's Institute Odyssey:

From Freshman to Professor



Life at MIT seems to suit Michael Short. Since arriving as a freshman in 2001, he's earned four Institute degrees, served as lecturer and research scientist, worked extensively with hot metal at the MIT Forge, and used the campus Hobby Shop to prototype an LED cinema lighting system now sold by one of the three companies he's helped found.

His 2013 appointment as assistant professor of nuclear science and engineering has made him even more of a fixture on campus; since then he has introduced new classes and established the interdisciplinary Short Lab to investigate new materials for nuclear energy systems. "I love it here," he says.

Short's lab is part of the Uhlig Corrosion Laboratory, which is overseen by his thesis advisor and mentor Professor Ronald Ballinger. Both faculty members have dual backgrounds in nuclear science and engineering and materials science and engineering; Ballinger holds appointments in both MIT departments, while Short has SB degrees in both disciplines, an SM in materials science, and a PhD in nuclear science and engineering.

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That's a powerful combination for studying corrosion in hostile reactor environments and adhesion mechanisms that cause fuel rod fouling. Short will soon complete a unique experimental facility, the CRUD Loop, which can precisely simulate conditions in nuclear reactor vessels and provide insights into the formation of CRUD (an abbreviation for 'Chalk River Unidentified Deposits'), which accumulate on fuel rods causing decreased efficiency and shorter fuel lifetimes.

"The Loop has been a big two-year endeavor," says Short. "It can handle 150 atmospheres of pressure, like a reactor; the next step is to ensure that it can maintain this at 350 degrees C. Then it's time to start running experiments — I can't wait." The Loop includes sapphire viewing windows large enough to allow the first real-time photography of CRUD formation.

Like many Short Lab projects, the CRUD Loop has benefitted from work by Undergraduate Research Opportunities Program participants (there were nine last semester). "Undergrads can do research as well as anyone; I came to MIT myself because they let me do research right away," says Short. "We've had freshmen present work at international conferences, and travel to Russia for research. Our department provides a home for students who come out of high school wanting to make a difference; why should they have to wait four years?"

Another Short initiative aims to create a new metric for radiation damage to materials. Today, scientists and engineers use multiple factors to assess damage, but some require destructive testing or human handling of radioactive material, and reproducibility has been an issue. "I would like to develop a standard, like the kilogram or meter, for radiation damage," says Short, though he's quick to acknowledge, "'easier said than done' is an understatement."

On the teaching side, Short's students in this year's Senior Nuclear Systems Design class (22.033) will face a new challenge. Rather than developing conceptual designs using PC-based simulation software, they will analyze a complex problem (void swelling in sodium-cooled reactor fuel assemblies) using supercomputer simulations that can take weeks to run.

"Engineers are expected to be able to do massive simulations these days," explains Short. "And the output will be a publishable journal article with proof of submission — they'll be required to condense their thinking and get the right messages across to a broad audience." The latter requirement is part of a department-wide effort to improve NSE graduates' communication skills — "science is 50 percent work and 50 percent presentation," says Short. "You don't get anywhere without both."

Ultimately, Short's ambition is to help nuclear materials evolve faster, so that the nuclear power sector can, too. "I just don't see a large-scale base load energy source that's clean and reliable outside of nuclear, once we've tapped all the geothermal and hydro we can," he explains.

And MIT NSE is an ideal place to apply the twin scientific tools of simulation and experimentation to the task. "I'm personally a big-time experimentalist," says Short. "But when you can get a simulation and an experiment to match up, or help a student design an elegant experiment that informs a simulation, that's truly exciting." ∎