Magnetic resonance microscopy research lands professor NSF award

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Montana State University engineering professor Sarah Codd has won a $400,000 National Science Foundation Career Award to advance her teaching and research in magnetic resonance microscopy. Credit: MSU photo by Jay Thane

A Montana State University professor has won a prestigious $400,000 Career Award from the National Science Foundation for her work in magnetic resonance microscopy, a technique that allows researchers to see the inner workings of devices as small as one-tenth of a millimeter in size.

Sarah Codd's work assists research on fuel cells, medical catheters and the cleanup of contaminated soil and water. The NSF Career Award is notable because it goes to a single person, whereas most NSF grants support teams of researchers. It is NSF's most prestigious award to support the early career development of teacher-scholars. Codd is MSU's

thirteenth winner since 1995.

Codd will use the funds – paid out over five years – to advance her research, teaching and public education of how magnetic resonance microscopy can be used to help solve a variety of pressing engineering problems.

This is the second major NSF award Codd has garnered in the past three years. She was awarded a $387,000 NSF Advanced Fellowship in 2004. Originally from New Zealand, she came to MSU in 2002.

Magnetic resonance microscopy (MRM) is based on the same principles as its better-known hospital cousin, magnetic resonance imaging, or MRI. However, MRM technology lets researchers see movies of fluids and gases moving through objects honeycombed with tiny channels.

"We know a lot about how water, or other fluids, flow through large channels, like rivers and the plumbing in your house, but there is a lot that's not understood about how fluids move through micro-channels," Codd said.

At this scale – smaller than the width of a human hair – the laws of physics, as most people know them, change: water can flow against gravity and molecules can stretch.

"Fluids behave very differently at small levels," Codd said. "We are able to create computer simulations based on physics about how fluids behave, but with MRM we can see inside objects to see if those simulations are correct and if that's how things really work."

About the size of a small chest freezer tipped on end, the MRM device allows Codd to look inside complex ceramics developed by MSU professor Stephen Sofie in his research on fuel cells. Codd, with Phil

Stewart, director of MSU's Center of Biofilm Engineering, looks inside tiny catheters to see how bacteria foul the lines. With the MRM, chemical and biological engineering professor Robin Gerlach is seeing how bacteria can be used to clean up soil and water contamination.

The Magnetic Resonance Microscopy Laboratory is housed within the College of Engineering, but collaborations reach across campus, the nation and world.

"We're not just researchers on our own specific problem," Codd said. "This is very interdisciplinary work."

The MRM lab currently has three undergraduate and six graduate students and a post-doctoral researcher working on different projects. Codd plans to use a portion of her NSF Career Award to create a course offering an overview of techniques available for engineers exploring the very small: MRM, optical microscopy, confocal microscopy, x-rays, scanning electron microscopes and atomic force microscopy.

"As the world moves to the nano scale, we're seeing a greater need for observations at that scale," Codd said. "But no single technique tells the whole story. Though very powerful, even MRM can't tell the whole story. It has to work in concert with other techniques. Our students need a background in what's available so they can help contribute to the development of these complex new materials."

Source: Montana State University