

OUR STORIES: MADHURI KUMARI, PHD STUDENT IN THE DODD-WALLS CENTRE

As a young woman growing up in India, the expectations for Madhuri Kumari were clear. She would become a teacher, get married and have a family. And that's the way she started out. But a few months into her first job as a high school science and maths teacher she quit. Much to the disappointment of her family she gave in to her passion for physics. She enrolled in a Masters at Hyderabad University where she focused on light and matter physics and fell in love with optics. Then, after spending two years as a junior research fellow at Raman Research Institute she left India for the first time and followed her passion all the way to New Zealand.



She is now in her second year of a PhD at Otago University under the supervision of DWC Associate Investigator, Richard Blaikie. Her research is pioneering a new type of sensor technology that uses light to detect different gases.

Madhuri's Research: Resonant absorption of light in ultra-thin films for gas sensing

The sensors are based on a novel phenomenon, which was first observed and reported in a [Nature article in 2012](#). You shine a light at an ultra-thin film of weakly absorbing material on top of a metal substrate and for certain wavelengths all the light is absorbed rather than reflected. It was a very surprising result and generated a lot of interest in the physics community. Madhuri's research has proved that such a system can be used for sensing applications. When gas molecules come into contact with the thin film they cause tiny electronic disturbances which affect its absorption properties. This can be picked up in the spectrum of light bouncing back.

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be a great advantage. Another major advantage is that the sensors are immune to electromagnetic noise which makes them suitable in settings like labs and factories where electronic sensors experience noise. They are also cheap to produce".

For her proof of concept work Madhuri created and tested films to detect water vapour for [humidity sensing](#). The next step is to alter the composition of the film to detect other gases of commercial interest.

At this stage they don't think there are any other groups working on the idea. But they would be very keen to share knowledge if there are.

What advantages do Madhuri's sensors have over existing technologies?

As Madhuri explains: "We are only just beginning to explore this technology. We believe it is going to improve the sensitivity and response time, which will

What attracted Madhuri to her PhD position?

Madhuri was looking for PhD positions all around the world when she came across Richard Blaikie's advertisement. When she googled him, she found out that he was involved in a piece of research that was close to her heart (it was an experimental demonstration of [silver superlensing](#)). "That was it!" she thought. "I want to go and work for this person!"

"I never wanted to move to New Zealand but when Richard's option came I realised it was just what I needed - a quiet, peaceful, beautiful, healthy place to live where I can focus on my research."

The New Zealand research experience

At first coming to New Zealand was a culture shock for Madhuri. "Back home, in family and professional life, people are very straightforward," she explains. "If your supervisor does not approve they will tell you: 'No, that is a bad idea. Don't do it. That sounds very stupid.'" In comparison kiwis are very polite.

Richard doesn't instruct. He allows you to make the choice. But at first I could not tell the difference between good and negative feedback because it all sounded good. I missed the point completely. Now that I have learnt to fine-tune my understanding, I am finding a freedom that is very rewarding."

In India research institutes have a whole lot of people who are there to help you. In New Zealand the culture is more 'do it yourself.' At first she didn't know how or when to ask for help. "We have an old vacuum pump in our lab that often breaks down. I used to be terrified of it." Madhuri said. "Then one day, rather than waiting for someone to come and fix it I started fiddling with the machine myself. A few years back I could not have imagined getting my hands stained with grease handling a whole beast of a machine. But now I'm like - 'yeah! You can do it girl!'"

In India Madhuri's dad was in the air force so she grew up in a defence campus with full security. Her parents were so worried about her coming to New Zealand on her own and she found it difficult at first. But now she is used to living here and feels very safe. "The New Zealand culture allows me to be who I really am," she says.

Student Opportunities in the DWC

Otago University provides lots of opportunities for students to get involved with outreach activities. Madhuri is part of the [Otago Optics Chapter](#), a student group that organises festivals, competitions and events. She has been to Queenstown twice to work with schools and is helping with a school science photo competition.

"I love the kids," says Madhuri. "They are so vibrant and energetic. Sharing science with the community is really important to me."

The Dodd Walls Centre has a strong focus on connecting and supporting students.

"It is a great community," says Madhuri. "There is so much cool physics going on and a really broad range of experience to draw on. I have grown so much since being here in ways I never expected."

