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Pratibha Gai’s award-winning focus

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L’Oréal-Unesco laureate discusses microscopes

Resolution to share: Pratibha Gai (far right) did not patent her technology because she wanted to encourage as much fundamental research as possible

Pratibha Gai recalls the day she made her breakthrough. “One day I was testing my instrument and with my own eyes, for the first time in the world, I saw atoms working in a chemical reaction, changing their atomic structure, and it was absolutely thrilling.”

In 2009, after years of development, Gai, who holds a chair in electron microscopy and is co-director of the York JEOL Nanocentre at the University of York, succeeded in creating a microscope capable of perceiving chemical reactions at the atomic scale. This is an advance on conventional microscopes at this scale, which can only view innate material in the “dead” conditions of a vacuum at room temperature.

With the help of colleagues, she built and refined the machine over two decades, beginning with a lower-resolution prototype when she was a postdoctoral researcher at the University of Oxford. She then spent 18 years in the US at chemical firm DuPont and the University of Delaware.

Gai returned to the UK in 2007 to join York, making her breakthrough two years later.

“Nobody had done that before, and it opened up a whole new field of materials research under reaction environments at the atomic scale,” she tells *Times Higher Education*.

In recognition of her work, on 28 March Gai will travel to France to receive the title of L’Oréal-Unesco For Women In Science European Laureate for 2013.

She is one of five female scientists from around the world, one from each continent, who will be recognised for their contribution to science at an awards ceremony held at the Paris headquarters of the United Nations Educational, Scientific, and Cultural Organisation.

The awards, which are presented in the life sciences and the physical sciences in alternate years, are determined by an international jury of eminent scientists, presided over by Nobel prizewinners.

The microscope Gai created - the atomic-resolution environmental transmission electron microscope (ETEM) - works by adapting a conventional electron microscope, drilling holes in its imaging lens to allow the researcher to create the right environmental conditions for reactions to take place.

“It’s like drilling a hole through the microscope’s heart,” Gai says of the process that led to the creation of the ETEM. “If we had made a tiny mistake we could have killed the machine, but we did careful calculations and measurements.

“Anyway, I believe that you have to take some intelligent risks to advance science.”

Chemical reactions in liquids, gases and the surface of catalysts are the lifeblood of many industries, including healthcare. Being able to watch these reactions take place means being able to control them better and devise new reactions, leading to novel medicines, energy sources and industrial products.

Gai’s interdisciplinary team at York is now developing tiny antibiotic particles for use in healthcare, as well as new chemical processes for renewable biofuels. The technology has also

contributed to the search for environmentally friendly ways to coat pigment particles for use in more durable polymers and paints.

No patents pending

Gai's invention has already been used worldwide to make discoveries with an estimated value of £250 million, but she will not see a penny of it.

Despite commercial collaborations (her lab at York is sponsored by JEOL, a firm that produces electron microscopes), she does not hold any patents related to her work.

"I thought that if I patented it, no one else would be able to do work with it," she explains. "I might earn some money, but I was not interested in that. I was interested in applications for many researchers, creating more fundamental science. So I decided not to patent it."

Although this decision sounds quite black and white, she says that in science it is often impossible to know how valuable a patent is going to be.

"For me at least, at the time [of doing the research] it was not clear it was going to be successful worldwide, and that's always the situation," she says.

"It was only later, when we developed the higher-resolution version [of the microscope] that people became really interested, and by then we had already published [the research]."

Does she regret the decision?

"If I had patented it, it would not have been known to so many researchers worldwide and the technology might not have been so successful, so no, I don't regret it," Gai says.

L'Oréal's involvement in the awards dates back to 1998. The many awards and fellowships in its programme to support women in science make no reference to the company's cosmetics and perfumes, or to the famous advertising slogan, "Because you're worth it".

But does Gai wish that an engineering or chemical company without explicit ties to the beauty industry were backing the scheme instead?

The only thing she would like to see is more awards of this type, she replies.

"It's an excellent award, and I hope more of these corporations follow L'Oréal's lead. Sometimes, because of a lack of encouragement or institutional bias, women's science doesn't get recognised."

Gai is a strong advocate of getting more women into what she calls the "competitive scientific world", and she hopes that her receipt of the award will encourage this, particularly in the physical sciences.

There were no female role models at Oxford when she was an early career researcher, she says, admitting that she found this discouraging. But Gai believes that progress has been made since then.

“There are female role models now for young women to look up to on the world stage,” she says.

Despite acknowledging that women must still sometimes work harder than men to succeed and that society and institutions should do more to encourage female scientists, she adds that the most important thing is “aiming high”.

This, Gai says, is “what’s needed to keep women in science; it’s a very competitive field and they [otherwise] lag behind whether they are working or not. So I keep telling my female students to aim high.”

Pratibha Gai

1981-88: Head of surface reactions and catalysis group, department of materials, University of Oxford

1988: Relocated to the US to work on nanotechnology as research fellow at DuPont Central Research Laboratory. Also held the role of adjunct professor of materials science at the University of Delaware

1995-97: Developed a microscope to allow observers to see chemical reactions occurring at the surface atoms of catalysts

2007: Returned to the UK to found the York JEOL Nanocentre at the University of York and hold the role of JEOL founding professor of electron microscopy, with chairs in the departments of chemistry and physics

2009: Made a breakthrough microscope that increased resolution to the atomic level

2010: Awarded the Institute of Physics’ Gabor Medal and Prize

2013: Becomes the fourth UK scientist to receive a L’Oréal-Unesco For Women in Science European Award, winning $100,000.