Novel nano-devices developed by U of T researchers

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(PhysOrg.com) -- University of Toronto researchers continue to uncover the mysteries of space. But even the best astronauts in the world are stymied if the spaceship doesn't launch. When the countdown stops, it is often because a hydrogen leak has been detected. One small malfunction in the sensing device can mean millions of dollars lost.

Thankfully, there is no failure to launch at U of T's new electron beam nanolithography facility where researchers are already developing smaller-than-tiny award-winning devices to improve disease diagnoses and enhance technology that impacts fields as varied as space exploration, the environment, health care and information and media technologies.

One of these novel nano-devices, being developed by PhD student Muhammad Alam, is an optical nose that is capable of detecting multiple gases. Alam hopes it will be used by NASA one day.

Alamis supervised by engineering Professors Mo Mojahedi, director of the Emerging Communications Technology Institute, and Stewart Aitchison, the faculty's vice-dean (research).

Boeing, a supplier of rocket engines for NASA, approached the team in 2007 with an urgent need for a compact and reliable hydrogen sensor. "Sometimes they have to cancel rocket launches because of false alarms from hydrogen sensors. That's what motivated us to work on designing a cheap and reliable hydrogen sensor," said Alam.

However, he said that was only part of the motivation. Hydrogen is a widely used chemical inmany industries. More than 50million tons of hydrogen was produced and used in 2004 by industries ranging from petroleum refineries to semiconductor processing facilities. The demand for hydrogen is growing bymore than 10 per cent per year. A cheap and reliable hydrogen sensor will help these industries handle hydrogenmore safely and efficiently.

Another motivation behind the work is the potential for use in environmental monitoring of various gases. "We are, of course, concerned about the environment; successful completion of our research could result in cheap sensors with the capability of detecting multiple gases in addition to hydrogen. This can be very useful for environmental monitoring."

Essentially the device consists of many silicon nanowires on a single chip. These are tiny silicon wires that can confine and guide light very similar to the way metal wires guide electricity. The nanowires are coated with material sensitive to hydrogen. Presence of hydrogen changes the amount of light coming out of the nanowires. Since they are so tiny there can be hundreds of themon a single chip and detecting many different gases by same chip is possible. In layperson's terms, Aitchison calls this the "optical nose" because it acts very much like a human nose that can sniff and detect various odours.

"For us the novelty is making them -- integrating multiple things on a single platform. It is very rewarding if the thing we make has practical applications."

The state-of-the-art e-beam lab officially opened Sept. 16 with a $6.5-million electron beam lithography system that can define features as small as 10 nanometres.