

# The Silicon connection

P. HARI

**A**T first sight, and by any conventional standards, Trident Metrology is quite an unusual entity. It comes close to being a virtual company but it is developing a concrete device. It has only one employee, its founder Prasanna Chitturi. The company is registered in Delaware, US, but has no formal office anywhere. Yet the device that Trident is developing, a mass flow metre, could be in great demand and has the potential to transform manufacturing in some high-tech industries. Trident is also of interest to India: it uses technology from the Indian Institute of Science (IISc) in Bangalore.

But the most interesting aspect of Trident is none of these. What is interesting is the unreal simplicity of its product. These days, a path-breaking product is expected to be sophisticated in every sense. Not Trident's mass flow metre, which uses simple science, simple technology and a simple design. So striking is the simplicity that potential customers are baffled and ask 'is that all?' after a sales presentation from Chit-

turi. Under normal circumstances, they might have shrugged it off, but they also know why this mass flow metre was not developed earlier: the scientific principle behind the product was discovered only two years ago.

In 2004, Ajay Sood, professor of physics at IISc, and his student Shankar Ghosh made a remarkable discovery: gases passing at a specific angle over certain kinds of wires can generate a voltage and, hence, a current in the wire (see 'Power Generation In Nanotubes', *BW*, 6 Sept 2004). Sood saw this effect first in carbon nanotubes but later found it in some semiconductors, too. It caused a lot of excitement in the scientific community because the commercial potential was clear: electricity could be generated, to mention the most quoted example, using wind-power but without using moving parts.

But the easiest and most obvious application of the phenomenon would be to measure the flow of gas. We need to measure gas-flow in a variety of environments from homes to state-of-the-art factories. A simple, fast, cheap and reliable method to do this would of great use to a large number of industries. IISc wasted no time in filing patent applica-

tions in major countries.

Chitturi had not heard of Sood or his discovery when he went to IISc a year-and-a-half ago. He was visiting the institute to see the Padmashri medal one of the professors then had got. A chemical engineer by training, Chitturi had worked in the semiconductor industry in the US for two decades, and was mulling over several new business ventures. At IISc, he was introduced to S. Gopalakrishnan, chairman of the patent cell, and before long, he was sitting with Ajay Sood talking about a company to develop gas flow metres. Thus was born Trident Metrology in 2005 with an investment of \$300,000 from various friends and acquaintances of Chitturi, all of whom were executives with semiconductor capital equipment companies. IISc was a stakeholder.

Chitturi lives in Pleasanton near the Silicon Valley. He could get any kind of work done — design, simulation, fabrication — by driving less than one hour from here. His family now lives in Bangalore near IISc; he could reach Ajay Sood within minutes of leaving his second home. The choice of the locations, thus, and his product could not have been better for his company. Chitturi started work by hiring consultants and contractors instead of employees. His contacts in the semiconductor industry paid off; several of them chipped in with their expertise. Prototype development started in mid-2006.

Mass flow metres, as we mentioned, are ubiquitous in many industries. They

## Simple Yet Useful

**I**F you blow gas over a wire or a plate, it normally flows over it without doing anything specific. If the plate is at an angle of 45 degrees to the gas flow, and made of carbon nanotubes or silicon, a current begins to flow through it. This is because the flowing air increases in speed as it flows, and thus creates a temperature difference between the two ends of the wire. This temperature difference creates a voltage across the wire and, thus, produces a current.

Interesting is also the fact that the strength of current flows is related to the speed of the air and is measurable even at very slow speeds. Even human breath produces a current that can be measured. The principle could be used in two ways then: to measure the speed of gas, and to generate electricity.



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## Virtually a one-man company, Trident Metrology takes IISc technology to the global market

### **SMALL FLOWS, HUGE GAINS: Prasanna Chitturi, founder, Trident Metrology**

are not sophisticated devices nor are the principles behind their operation overly complicated. Most of them use thermal principles. A gas flowing over a warm coil cools it, and this fall in temperature changes its resistance. The amount of resistance change gives an indication of the amount of gas flow. But most of these metres have a problem of accuracy when it comes to measuring small flows, where they have error rates of around 2-3 per cent or even higher. They are not that quick either. Measuring micro-flows accurately is becoming key too. "We are still struggling to measure micro-flows," says S. Saseendran, director of the Fluid Control Research Institute (FCRI), Palakkad, Kerala. "Anyone who can get high accuracies in measuring micro-flows can bring about a revolution in industries such as pharmaceuticals and semiconductors." This institute, being one of the few in the world with the ability to test and

calibrate high-precision fluid flow equipment, will figure prominently in Chitturi's future work, when he decides to test his device.

The credit for making the first working model of the mass flow metre goes to Ajay Sood. Associates in the Silicon Valley helped Chitturi refine and develop the device further. Many of them had worked at labs like the Jet Propulsion Laboratory, the Palo Alto Research Centre, and the semiconductor equipment company Applied Materials. Netflow Research, an Arizona-based company, helped with the circuit board design. Another California company called EMC Scientific helped with the early stage testing. Now the gas flow metre is getting ready for final testing. Chitturi will then bring it to FCRI in Palakkad, sometime next month.

If it works as predicted, the mass flow metre based on the 'Sood Effect' could transform some practices in the semiconductor manufacturing industry. This industry has to use different

flow metres for different rates of flow. The new flow metre would work in almost the entire range, thus helping companies to reduce their inventory. As semiconductor manufacturing deals with smaller and smaller transistors, the accuracy of gas flow measurement becomes more and more critical. So, companies could use the new gas flow metres increasingly. What baffles industry observers and even some investors is still its simplicity, says Chitturi.

What Trident would sell is a mass flow controller (MFC), of which the flow metre would be a part. Chitturi would have to get funding to expand the company once the prototype is ready. It may not be difficult as Trident has the rights to the technology in the semiconductor and related industries for the next five years, including new developments during this time. Yet the potential to use the 'Sood Effect' extends beyond these industries. It extends beyond even mass flow metres, into generating electricity. Who will take that up? ■