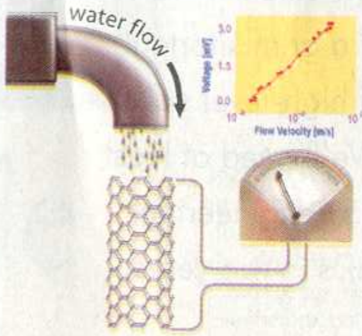
Nanotechnology

Yet another marvel of the miniaturisation revolution, nanotubes will find extensive use in our lives in the days to come.

This was Year 2002. When Ajay K. Sood, physics professor at the Indian Institute of Science (IISc), and his then student Shankar Ghosh began experiments to study the effect of liquid flow in carbon nanotubes—tubes smaller than a strand of human hair—the two knew they were on to something big. What they found was dramatic: the flow of liquids in the miniature tubes generated electric current.

A year later, Sood and his colleagues took the experiment further and studied if gas flow could also generate electricity. In a paper published in the prestigious physics journal, *Physical Review Letters*, in August 2004, the scientists reported "an equally striking effect for gas flow as well, but for fundamentally different reasons". The findings have already earned Sood and his colleagues flattering comparisons with Sir C.V. Raman's discovery of the Raman effect. The discovery itself has got itself the nickname 'Sood Effect', and has spawned several patents and possible path-breaking applications. "It was not serendipity that led us to our findings. We were driven by an idea and were looking for effects," says Sood.

One of the most exciting applications to emerge from the discovery is the possibility of a heart pacemaker-like device with nanotubes, which will sit in the human body and generate power from blood. Instead of batteries, the device will generate power by itself to regulate defective heart rhythm. "We have shown that electric currents can be generated in bio-medical environments like blood and saline solution. We see a lot of potential for applications in a pacemaker-like device, as well as for directly measuring blood velocity. A great deal of work still needs to be done in collaboration with biologists, bio-medical engineers and others for final solutions to evolve," says Prof. Sood.



In the past too, scientists have been researching on the application of nanotubes in the human body. In 1999, US scientist Ray Baughman and his colleagues reported that nanotubes act like human muscles if electrical energy is supplied to them in a particular way. They reported that muscles made of nanotubes could be more durable than human tissue.

To take their findings further, Prof. Sood's team is currently studying the binding of DNA to nanotubes. "We are trying to find out which DNA or nucleotide sequences bind best with carbon nanotubes. Answers to these questions are not known and people are just beginning to understand this," says Prof. Sood. Talks are also on with possible collaborators to use the liquid flow technology in medicine, he says.

"A few companies have talked to us, but we have not converged on a deal. We are hoping for collaborations. This will speed up the development of an application. We need to develop certain methodologies, so that something does not corrupt the system. If an unwanted protein sticks to the nanotubes, the effect could be camouflaged. We have demonstrated that it is possible in a toy model. Real life is still to be explored," Prof. Sood points out.

The gas flow discovery by the team has, in comparison to the liquid flow finding, seen a better takeoff in terms of applications. The IISc team has transferred exclusive rights for the technology to American start-up Trident Metrologies, to develop prototypes and marketable gas flow sensors. "It has taken a more serious turn because there is a huge demand for hi-tech, reliable and more digital gas flow sensors in gas pipelines," says the scientist. Based on their two discoveries, the scientists have also filed for two more patents to use nanotubes as vibration sensors inside a liquid and as an accelerometer to detect vibrations on solid surfaces—like during an earthquake. Work is also in progress to study whether double-walled nanotubes can give composites greater strength.

—Johnson T.A.