NAVAKANTA BHAT (Professor, Centre for Nano Science and Engineering)

LARGE IMPACT THROUGH SMALL DEVICES

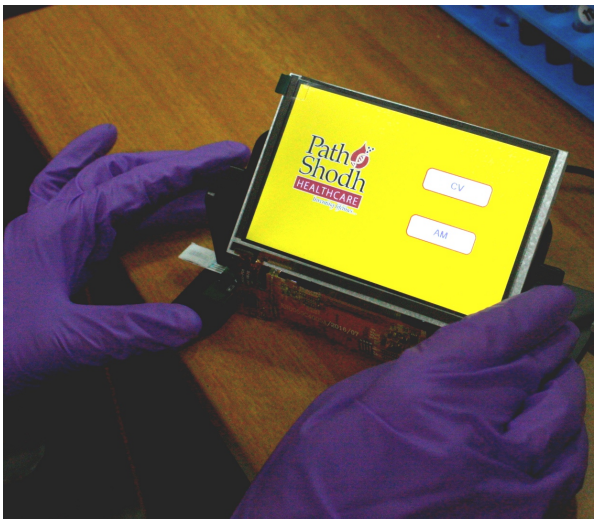
For decades, silicon transistors have been shrinking in size. But silicon is no longer a suitable material when transistors become smaller than 10 nanometres.

Navakanta Bhat is interested in semiconductors that could replace silicon, especially 2D materials such as molybdenum disulphide (MoS_2). His research group has developed an ultra-low power switch by integrating an MoS_2 substrate with a gate made of a material with a high dielectric constant, such as hafnium dioxide (HfO_2), using nanotechnology.* “We have been able to demonstrate MoS_2 nanotransistor with record mobility using HfO_2 gate dielectric and sulphur-treated nickel contacts,” says Bhat.

Bhat’s research group also uses nanoscience to develop gas sensors and biosensors. One of the gas sensors they have fabricated can detect carbon dioxide in the range of 300 to 1000 parts per million.** “This novel low-cost sensor is made by placing a thin layer of mixed metal oxide semiconductor, such as oxides of barium, titanium and copper, doped with silver, on a micromachined suspended hotplate,” says Bhat.

Navakanta Bhat's group aims to create societal impact through basic research in nanotechnology and its translation to realize novel products

Bhat's work on biosensors has focussed on the management of diabetes and its complications. His group has developed new electrochemical receptors for sensing of HbA1c (glycated haemoglobin), glycated albumin, blood glucose, haemoglobin, serum albumin, micro-albuminuria, urine creatinine and urine ACR. They have also invented a phablet-sized handheld device that can perform these multiple tests in less than a minute, using no more than a drop of blood or urine. The device, which uses special disposable



A protptype of the diabetes detection and monitoring device which is to hit the market

test strips, is now being commercialised under a company *PathShodh Healthcare* that Bhat co-founded with one of his students. The technology is now protected by multiple international patents. It has also been shortlisted by the National Health Systems Resources Centre (NHSRC), a central government agency that works in collaboration with the World Health Organization, as a "priority medical device" because of its potential healthcare benefits.

* KL Ganapathi, S. Bhattacharjee, S Mohan, and N Bhat. 2016. High-performance HfO_2 back gated multilayer MoS_2 transistors. *IEEE Electron Device Letters*. 37(6):797-800

** SB Rudraswamy, N Bhat. 2016. Optimization of RF sputtered Ag-doped $BaTiO_3$-CuO mixed oxide thin film as carbon dioxide sensor for environmental pollution monitoring application. *IEEE Sensors Journal*. 16(13):5145-5151