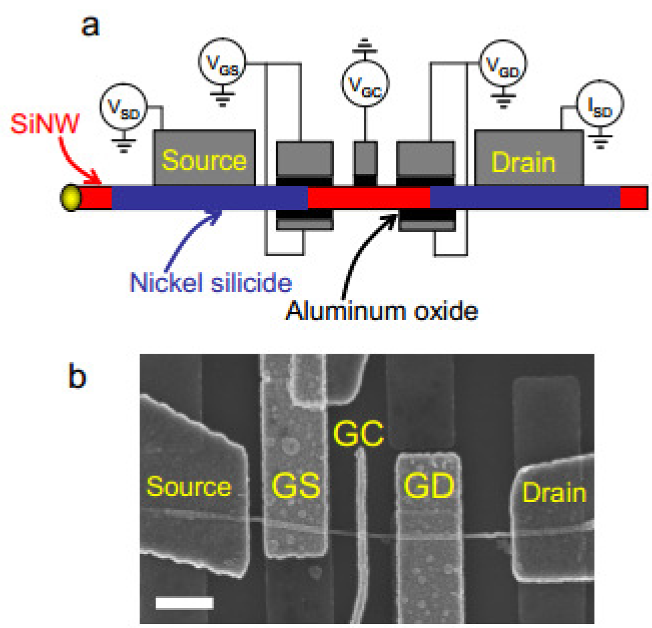
New Technology for Silicon nanowires based electronics capable to rectify signals at very high frequencies close to the optical ones



" All images used are for illustrative purposes only. The material available on this website is provided for general information and education purposes only. All images are copyrighted by their respective owners "

A research organization has developed a new technology to make diodes, transistors and logic gates from pure silicon nanowires, without the need for dopants.

As there's a problem because at the nanometre scale, the electronic properties of silicon can depend on the precise location of only a few dopants. That's difficult to control and causes wide variation in device performance. Consequently, nobody has been able to make reliable diodes, transistors or logic gates out of silicon nanowires until now when a research organization has demonstrate a way out of this conundrum. These guys show how to fabricate diodes and transistors from undoped silicon nanowires and how such devices can be wired together to make logic gates.

Making electronic devices from undoped silicon has always been tricky because of a phenomenon known as a Schottky barrier which occurs at the junction between a metal and a semiconductor. The electrons in the metal tend to push away the electrons in the semiconductor allowing current to flow in one direction but not the other.

That sounds useful and indeed it is in certain circumstances when it can be used as a diode. The problem occurs when rectification is not required and the junction must work in both directions. The Schottky barrier prevents this.

The researchers have got around this problem by carefully coating the nanowire with metal silicides at the junction with a metal contact which prevents the formation of unwanted Schottky barriers.

As a result, they've created a device that they operate as a bipolar transistor, a Schottky diode and a p-n diode. The gain on their transistor is significantly more than 1 meaning that the output from one can be used as the input of another without additional signal restoration. Finally they link a couple of these devices together with external leads to create a NAND logic gate.

The researchers have also described an innovative technique for making silicides an Silicon nanowires through a patented process by which it is possible to fabricate fast tunnel diodes capable (in principle) to rectify signals at very high frequencies close to the optical ones (10^15 Hz).

This kind of fast devices have the ability to rectify signals in the infrared and visible spectrum that has huge impact in terms of applications, namely energy conversion through rectification of the solar radiation (rectennas) or infrared detectors to cite only two.

Solid-state devices (Schottky diodes) capable to rectify microwave frequency are already present but no device can operate in the infrared and visible because they are not fast enough to follow the electric field which oscillates very rapidly. Tunnel Diodes can do the job.

To make it short, imagine a Metal Silicide/Silicon Nanowire/Metal silicide nanostructure. If the silicon length is of the order of 10nm and assuming 20nm diameter Silicon Nanowire, this translates in a capacitance of the order of 10^-21 F which multiplied with the typical resistance of the junction ~100MOhm gives a cut-off frequency in the near-infrared (10^13-10^14 Hz). No solid-state device can operate at such frequencies.

For Additional Information please contact info@technologyconcepts.in