Junctionless transistor

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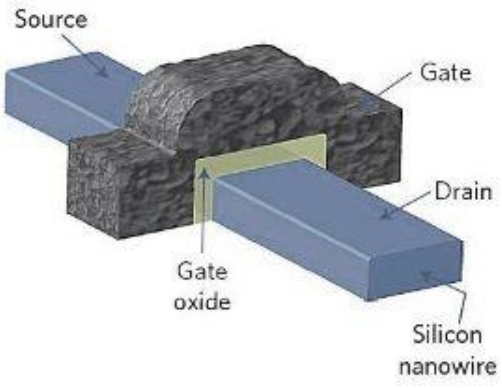
The first junctionless transistor was designed by Irish physicians from the Tyndall National Institute. This invention can cause a revolution in microchip production. It is interesting that the general principle of such devise was proposed as far back as 1925 by Austrian-Hungarian physicist Julius Edgar Lilienfield but today nobody could be able to construct it.

The transistor is the fundamental building block in all electronic devices. Since the early seventies the number of transistors in a silicon chip has grown from a few hundred to over two billion transistors on a single chip nowadays. As a result transistors are becoming so small that its traditional architecture can no longer be used. The new invention eliminates barriers preventing the compression of microchips.

The new version of the device consists of a silicon nanowire in which current flow is perfectly controlled by a silicon gate that is separated from the nanowire by a thin insulating layer. The structure itself is very simple, looking a bit like a telephone cable that is fixed to a surface by a plastic clip (watch picture 1).



Picture 1 Scheme of the junkless transistor

Crucially, there is no need to alter the doping over very short distances. Instead, the entire

silicon nanowire is heavily n-doped, making it an excellent conductor. However, the gate is p-doped and its presence has the effect of depleting the number of electrons in the region of the nanowire under the gate.

If a voltage is simply applied along the nanowire, current cannot flow through this depleted region. According to one of the scientists, professor Colinge, this region "squeezes" the current in the nanowire in the same way as the flow of water in a house is stopped by squeezing it. However, if a voltage is applied to the gate, the squeezing effect is reduced and current can flow. The team of physicians also made a similar device with a p-type nanowire and n-type gate. Moreover, the device also has near-ideal electrical properties; it behaves like the most perfect of transistors. This means that it hardly suffers from current leakage – the bane of conventional devices – and so could potentially operate faster and using less energy.

The invention is very attractive for producers as it is simple to build, even at the nanoscale, which means reduced costs compared with conventional junction fabrication technologies, which are becoming more and more complex and expensive. At the moment the researchers negotiate with companies –producers of semiconductor schemes to develop this technology.

Bibliography:

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