MAKING A TECHNOLOGY WORK: FROM NANOWIRE SCIENCE TO A REAL DEVICE

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Nanowires could be a good candidate to overcome some of the problems arising in the further miniaturization in electronics where the established top-down fabrication techniques are approaching its fundamental limits.

To integrate the nanowires with existing technology, the wires should be positioned on substrates like silicon. To avoid the usual pick-and-place methods of manipulating and aligning horizontally lying nanowires, it is beneficial to grow the nanowires directly on a conducting surface. In this case, one contact is already provided in the growth process.

Many prototype room-temperature devices have already been demonstrated, such as single-nanowire field-effect transistors, diodes [1] and logic gates combining both n-type and p-type nanowires. But it requires a lot more to realize a technology based on nanowires. To make such a technology work, there should be quantitative control over the doping level and the luminescence efficiency of the nanowire building blocks and reproducible electrical contacts are required. Another important aspect is the need to grow wires on specific locations.

We grow InP wires via the vapor-liquid-solid pulsed-laser-deposition method. The technological issues which we address here are the following: Firstly, the control of the doping level in the nanowires and the contact resistance with the substrate. The amount of charge carriers in the wires and the contact resistance was determined with field-effect devices [2,3]. Secondly, the surface passivation of the InP wires which enabled us to increase the photoluminescence efficiency of the as-grown wires by a factor thousand. Thirdly, the geometric control of the wires. We have been able to grow InP wires and tubes by a simple variation of the growth conditions.

References:

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