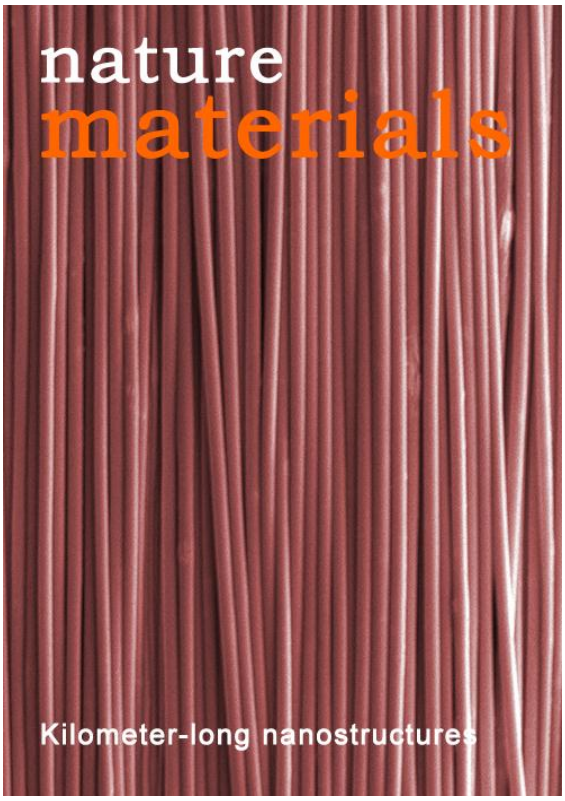
Producing Kilometer-long Nanostructures

It is not often that prefix multipliers *kilo-* and *nano-* come together; and when they do exclusively in the opening chapters of physical sciences textbooks the point being made is that the universe around us spans enourmous space and time scales while operating in unimaginably small ones. We are truly awestruck and inspired by the tension. Kilometer long nanowires do have a similar eponymous echo.

Nanowires, manmade materials only a few nanometer in diameter with properties unusually attractive to make them the focus of nanotechnology and materials research today, are rarely a fraction of a millimeter long. They are especially interesting due to their one dimensional structure through which they can be used as interconnects and when crossed over as switches or pixels. Miniaturization is sought everywhere in technology, it means much less power to operate, much quicker response time and high packing density. Here is the catch, though. How do you collect, manipulate these semiconducting bacteria and then connect to our world? Nanowires' promise might be appealingly big but their sizes are *too* small.



The chemical synthesis of nanowires and connecting them as functional devices has been perfected to a degree that now it is possible to grow nanowires with radial and axial heterogenous materials, to make branched wires and connect a large number of them as transistors for computation or customize their structure for high resolution celluar sensing.

These are all prototype devices, high scale integration and mass production impeding their wide application beyond research laboratories. The main hold back being their alignment, positioning and integration to large scale systems, microelectronics for example. The chemical synthesis method in most instances requires a post-processing step to devise functional devices from the nanowires. A new fabrication method is therefore welcome to address these issues. Kilometer long nanowires is a novel approach to nanowire fabrication that might bring with it fresh solutions.

The new fabrication technique, reported in *Nature Materials* by Bayindir research group at UNAM-National Nanotechnology Researsh Center, Bilkent University is essentially a size reduction technique. Controlled thermal size reduction is repeated iteratively until a macroscopic rod is scaled down to nano sizes radially while elongated axially. In this way a variety of semiconducting, piezoelectric and polymer nanowires and tubes can be produced. Millions of ordered indefinetely long nanowires, nanotubes, and one dimensional core-shell structures are obtained in a protective polymer. The nanostructures are aligned and ready to be connected to large scale systems through the facets of the fiber in order to use their nano features, such as photoconductivity or phase change properties. But the use of the structures is not confined to electronics, thsese nanowires can be used in large area photonics applications as non-pigment colors, in next generation solar cells to improve efficiency as effective light concentrators too. It seems fiber drawing has just been reinvented in the age of nanotechnology.