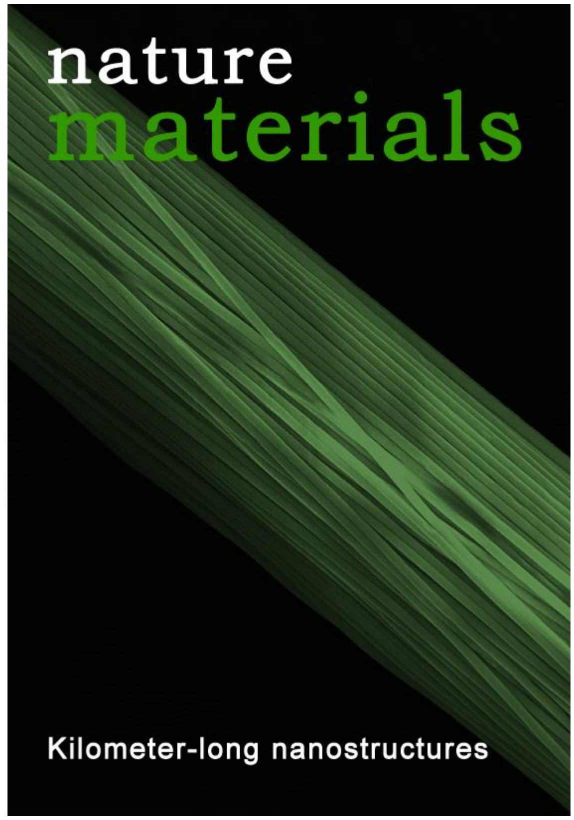
About the work

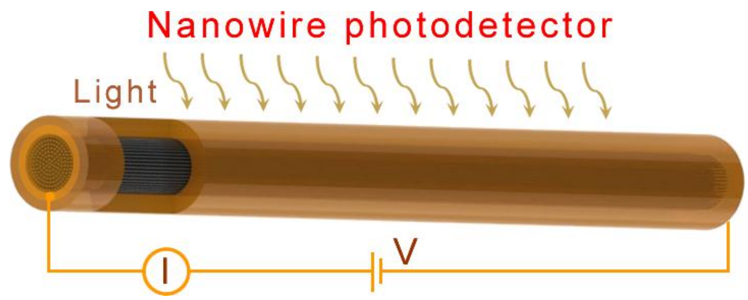


In this work, we demonstrated a unique, high-throughput, lithography free nanofabrication method to produce macroscopically large nanowire and nanotube arrays. The nanostructures are indefinitely long, ordered, uniform, high density arrays embedded in a flexible polymer fibre matrix. Diverse multimaterial sets and disparate combinations are used to obtain crystalline semiconducting nanowire arrays, chalcogenide nanowire array waveguides, piezoelectric polymer nanotubes and cylindrical core-shell structures. It is an open question if molecular wires can be obtained using the method. The ultimate size reduction for the nanowires need to be studied by optimizing drawing parameters for thermo-viscous materials, and materials that melt during drawing, separately. On the other hand, material set can also be widened to include semiconductors that soften/melt at higher temperatures using suitable glassy matrices.

New frontiers in nanofabrication

- Preserving nanoscale order and uniformity over kilometer length scale
- Achieving of ultimate size reduction 10^6 of disparate materials having semiconducting and piezoelectric properties
- Producing nanowires, nanotubes, core/shell structures with a world record aspect ratio of 10^{11}
- Interfacing of nanowire and nanotube arrays to micro and macro systems
- Producing high-throughput, low-cost, large area, and flexible nanowires and nanotubes.
- Polymer encapsulation of nanowire and nanotube array for easy handling, preserving order, interfacing and dielectric isolation,
- Opening up unusual device geometries

Impacts



We expect that a whole new family of radically novel nanowire applications will be enabled due to the unique geometry and used material set. We identify a number of enticing applications that are of current and rigorous scientific and technical interest. For example, these nanostructures can be exploited in nanowire electronics, as large area conformal photodetectors, large area flexible nanowire sensors, scalable high-density nanowire based phase change memory, and in high-speed reconfigurable field effect transistors; in energy harvesting, large area cylindrical heterostructure nanowires can be used as active cells, but also for passive light enhancement in resonance-enhanced third generation photovoltaics; in semiconductor nanophotonics, polymer embedded chalcogenide nanowires can be used as high-refractive index dielectric structures for size dependent absorption, structural coloring and biomimicry, and as dielectric metamaterials; in nonlinear photonics, ordered nanowires can be used as high power zero-dispersion optical arrays for new frequency generation and in discrete optics; in mechanics, nanowire embedded high strength composites; in acoustics, as flexible piezoelectric nanowires and nanotubes can be used as sensors and actuators , pumps, energy harvesting and nano-channels in nano-fluidics.