The Work

In the ongoing race to make phones smaller, thinner, stronger, and increasingly functional, Nokia is already beginning to apply nanotechnologies. But to deliver a product like Morph is an entirely different story. How do we make sure the right work is happening?

Our challenge is to understand technologies today that will still make sense in 2015 or 2020—especially as new technologies lead to sometimes surprising applications. Given a lead time of 10 to 15 years for a solution like the mobile gateway device, our work is well under way. Following are examples of areas of investigation that may support Nokia's mobile gateway vision.

Sensors and Sensing Everywhere

Sensors integrated into future devices will construct a complete awareness of the user context—both personal and environmental—enabling an appropriate and intelligent response.

Nanoscale sensors

Nanotechnologies can be used to create new building blocks and materials that improve both the resolution and the stability of microsensors. This is in part because nanocomponents have an immense surface area–to-volume ratio, allowing plenty of space for chemical reactions.

Nanostructures can also enable robust chemical and biochemical sensing, especially in scenarios where nanoscale values are being measured. And since nanoscale is the scale of the fundamental processes of life, nanoscale chemical sensors can leverage principles and materials common to biological systems.

Nanowire lithography on silicon

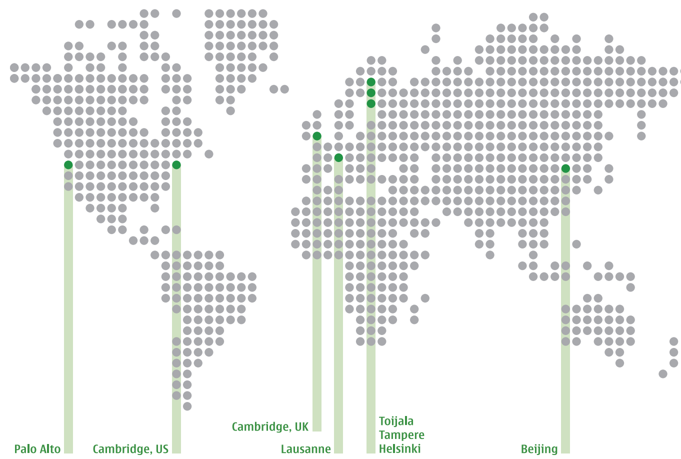
To improve sensor and signal processing characteristics, nanotechnology can yield innovative fabrication techniques that exploit the building-block nature of nanocomponents. Scientists at Nokia Research Center and the University of Cambridge have demonstrated a versatile new nanowire lithography (NWL) process for fabricating a range of ultrasmall, large-area, and self-aligned 3D architectures.

By applying chemically grown silicon nanowires as etch masks, the research team stenciled nanowalls into thin films of silicon (Si), producing interesting electronic transport effects. This same lithographic method can be applied to create patterned nanostructures of other materials besides Si, such as metals or graphene.

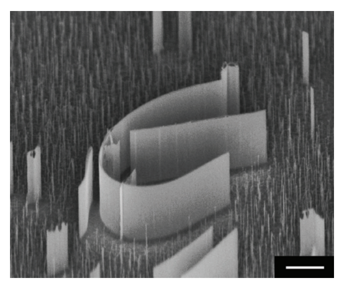
The applications of NWL also extend into the third dimension. Under proper conditions, a periodic undercutting can be obtained during etching, producing an array of vertically stacked nanowires from a single nanowire mask. Together, these and other Nokia projects highlight the potential of this NWL process for next-generation nanoelectronics, sensing, and electromechanical systems.

World-class collaboration network

Long-term scientific and commercial impact isn't produced in a vacuum. That's why Nokia collaborates with leading research centers in universities around the world, including Stanford, MIT, the University of Cambridge, and the Technical University of Helsinki/TKK. This culture of open innovation combines empirical research—hands-on work with basic materials—with goal-oriented industrial R&D that will result in game-changing technologies and products.

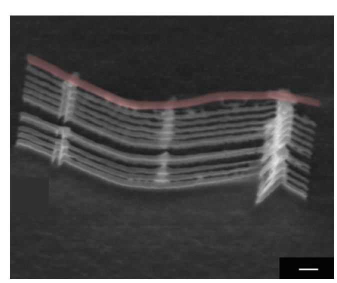


3D architectures using nanowire lithography



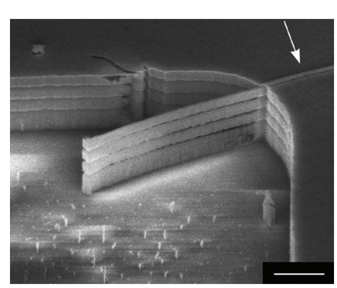
Scale bar = 2 micrometers

Scanning electron microscope (SEM) image of deep nanowalls fabricated using nanowire lithography. The nanowire masks were initially dispersed from solution, and two of them were randomly assembled to form the € (euro) symbol. The symbol was then carved into the Si wafer using deep reactive ion etching (DRIE).



Scale bar = 100 nanometers

Array of vertically stacked nanowires obtained via undercut from a single nanowire mask (pink). The height and separation of the nanowires within the array are controlled by the DRIE parameters.



Scale bar = 1 micrometer

Aligned array of suspended silicon nanocantilevers obtained by clamping—before the etching process—one-half of the original nanowire mask with a protective pad (arrow).