From basic Nanowire research to real-world applications

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Semiconductor nanowires are 'needle'-like structures with unique materials, electronic and optical properties that renders them promising for next-generation applications in fields like opto/electronics, energy systems and life sciences. An intensive and world-wide research effort in the field of nanowires was launched in the late 1990s, about ten years after the pioneering work by Dr. Hiruma at Hitachi, Japan. In my research group we spent the first five years on fundamental studies of the materials growth and the materials physics of nanowires, especially heterostructure systems [1], while in parallel also developing novel methods that combined top-down patterning with bottom-up self-assembly, to enable the reproducible fabrication of perfectly ordered nanowire arrays [2], [3].

From around 2005 it became evident that this blue-sky materials research [4], [5] offered significant advantages and opportunities for various applications, primarily in enabling high-speed [6] and optoelectronics devices by monolithic integration of III-V nanowires with silicon [7]. We have also explored ways in which these nanostructures can be used for energy scavenging [8] and in applications that enable energy conservation [9].

In this talk I will also present my perspective of broader materials research considerations related to semiconductor nanowires, what the state-of-the-art is, what the key challenges are and focus particularly on the opportunities that these nanostructures present in terms of realizing the next-generation of high-performance optoelectronics devices such as solar cells and light-emitting diodes, at a low cost and with low materials consumption [10].

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