Symposium NW03: Progress in Developing and Applications of Functional One-Dimensional Nanostructures

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Symposium Organizers:
- Juan Beltran-Huarc, Harvard T. H. Chan School of Public Health
- Wojciech Jadwisienczak, Ohio University
- Alessandro Pore, National Research Council
- Bo Zou, Jilin University

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Low Temperature Synthesis of Germanium Nanorods and Nanowires

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Abstract

Germanium nanowires and nanorods have a broad spectrum of potential applications including electronic devices, lithium ion batteries, sensors etc. However, the synthesis of these anisotropic nanostructures usually requires temperatures >300 °C, hampering the growth on temperature-sensitive materials such as polymers. We present in this contribution the growth of highly crystalline Ge nanowires and nanorods at temperatures as low as 170 °C. These structures grow either via the solution-liquid-solid (SLS) or the vapor-liquid-solid (VLS) mechanism depending on the growth conditions. In addition, we can show that the slow growth of these structures at low temperatures is due to the precursor decomposition characteristics as a limiting factor. Moreover, the decomposition of the Ge precursor is catalyzed by the presence of Ga seeds. Ge nanowires have been characterized by different analytical methods including TEM, EDX as well as XRD and the incorporation of unusually high Ga contents of up to 3% in the Ga structures has been observed. Unusually high metal incorporation in group IV nanowires has been observed for other semiconductormetal combinations [1] and helped targeting metastable compositions [2]. Therefore, electrical characterization of individual Ge nanowires has been performed in order to quantify the impact of the Ga incorporation on their conductivity [3]. According to the phase diagram, Ga has excellent potential for the Ge nanowires formation at even lower temperatures using suitable Ge precursors, which will be targeted in future studies.