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Symposium EM10: Solution-Processed Inorganics for Electronic and Photonic Device Applications

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8:45 AM - EM10.03.03
Low Temperature Synthesis of Germanium-Based Nanorods and Nanowires

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Hide Abstract

Semiconductor nanowires are very promising building blocks for devices and at the same time ideal model systems to study materials properties. Germanium and Ge-based nanowires and nanorods have a broad spectrum of potential applications including electronic and optoelectronic devices, lithium ion batteries, sensors *etc*. The synthesis of these anisotropic nanostructures usually requires temperatures >300 °C hampering the growth on temperature-sensitive materials such as polymers.
We present the growth of highly crystalline Ge as well as $Ge_{1-x}Sn_x$ nanowires and nanorods at temperatures below 200 °C. These structures can be grown 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 since no decomposition products are obtained in their absence. The 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% [2] and also high Sn contents of up to 20% in the Ge structures has been observed. Unusually high catalyst incorporation in group IV nanowires has been observed for other semiconductor/metal combinations and helped targeting metastable compositions [3]. Therefore, electrical characterization of individual Ge-based nanowires has been performed in order to quantify the impact of the heteroatom incorporation on their conductivity. In addition, the thermal stability has been investigated in XRD studies.

[1] S. Barth, F. Hernandez-Ramirez, et.al. *Prog. Mater. Sci.* 2010, *55*, 563.
[2] P. Pertl, M.S. Seifner, A. Lugstein, S. Barth, *manuscript submitted*.
[3] M. S. Seifner, F. Biegger, A. Lugstein, J. Bernardi, S. Barth *Chem. Mater.* 2015, *27*, 6125.