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Program

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Nucleation, Growth and thermal Stability of $Ge_{1-x}Sn_x$ Nanowires and Nanorods

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Direct band gap materials that are compatible with the silicon based semiconductor technology are desirable components for light emission in the mid-IR range. One promising candidate to achieve this goal is a germanium-tin alloy. However, the theoretically required Sn content of ~ 11 % to convert Ge to a direct band gap material [1] exceeds the solid solubility of < 1 % according to the binary phase diagram of Ge and Sn [2]. Therefore thermodynamically controlled processes are not feasible for the growth of this metastable material composition.

We are interested in the growth of $Ge_{1-x}Sn_x$ nanowires with Sn contents above the predicted transition point of $x = 0.11$. The nanowires are synthesised in a low temperature solution based process using metalorganic precursors in combination with microwave assisted heating enabling growth by kinetically driven processes [3, 4]. The successful synthesis enabled the incorporation of up to 30 % of Sn into the Ge lattice by this procedure, paving the way to potential band gap engineering of bottom-up grown $Ge_{1-x}Sn_x$ nanowires.

Independent and complementary methods including X-ray diffraction, Raman spectroscopy, and EDX elemental mapping are used to determine the Sn content, while TEM confirms the high crystallinity of the obtained products. The results presented in our contribution show new features of a low temperature nucleation regime and the impact on the obtained Sn concentration within the nanowires as well as their thermal stability [5]. These results will help to understand the nucleation and growth process in absence of a template and undesired growth promoters.

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[2] R. W. Olesinski, G. J. Abbaschian, *Journal of Phase Equilibria* **1984**, *5*, 265-271.

[3] M. S. Seifner, F. Biegger, A. Lugstein, J. Bernardi, S. Barth *Chem. Mat.* **2015**, *27*, 6125-6130.

[4] S. Barth, M. S. Seifner, J. Bernardi, *Chem. Commun.* **2015**, *51*, 12282-12285.

[5] M. S. Seifner, A. Romano-Rodriguez, S. Barth *submitted*.