Novel (EuIn)As/InAsSb Nanowires Grown by MBE

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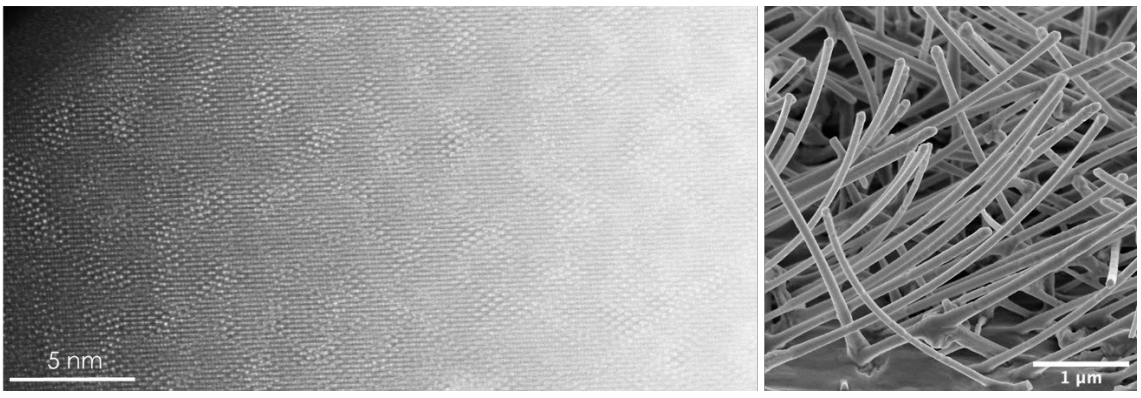
$EuIn_2As_2$ is among a vast list of newly emerging Zentil compounds[1,2]. This work focuses on growth and study of novel, (EuIn)As/InAsSb nanowires (NWs) produced by Au-assisted vapor liquid solid (VLS) molecular beam epitaxy (MBE). (EuIn)As shells were grown on three different core NWs: wurtzite (WZ) InAs, zinc blende (ZB) stalactite InAs NWs, and ZB $InAs_{0.9}Sb_{0.1}$ NWs. Molecular Dynamics simulations support the substantial difference between (EuIn)As shell formation on WZ and ZB, where the latter proves to be a significantly better host for Eu atoms.

Morphology, structure and composition of the Eu containing NWs were studied using SEM, HR-TEM, HAADF-STEM and EDS. A unique ZB-like mosaic structure is typical of the (EuIn)As shell regardless of the core. We obtained particularly interesting information regarding the atomic coordination of the eight fold Eu situated between two As layers. Interestingly, Eu ions induce inversion domain boundaries (IDB), inducing a flip of the InAs lattice, similarly to what has been reported in bulk $EuIn_2As_2$. The Eu atoms are situated along the three {111} planes forming a prismatic structure[3]. The as grown NWs and unique crystal structure are seen in the images below.

Low temperature SQUID magnetic measurements confirm that all nanowires show a magnetic signal though we cannot confirm whether they are paramagnetic, antiferromagnetic or noisy ferromagnetic. A small group was found to show a DC ferromagnetic signal. We are able to relate these results to the unique crystal structure and proceeding to growth of EuInAs ternary NWs.



HAADF image of unique crystal structure (left); SEM of as grown (EuIn)As/InAsSb NWs (right).

Key Words: Zintl compounds, EuInAs, nanowires, core-shell

1. J. Yan, Z. Z. Jiang, R. C. Xiao, W. J. Lu , W. H. Song, X. B. Zhu, X. Luo, 2 Y. P. Sun, and M. Yamashita, Physical Review Research, 4 (2022) 013163.
2. A.B. Childs, S. Baranets and S. Bovev, Journal of Solid State Chemistry, 278 (2019) 120889.
3. H. Shtrikman, M. S. Song, M. A. Zaluska-Kotur, R. Buczko, X. Wang, B. Kalisky, P. Kacman, L. Houben and H. Beidenkopf, Nano Letters, 22 (2022) 8925.