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Flux Induced Crystal Phase Transition in Vapor-Liquid-Solid Growth of Indium-Tin Oxide Nanowires

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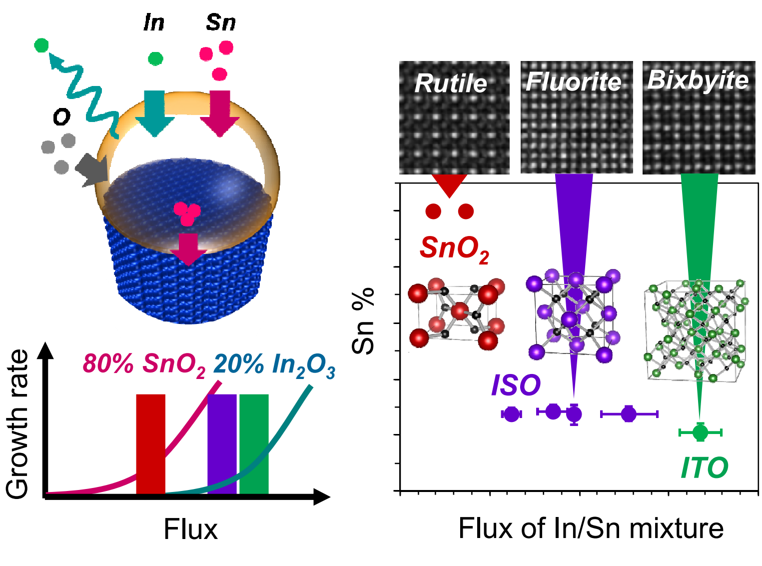
Metal oxide nanowires formed via vapor-liquid-solid (VLS) route provides a research platform not only for investigating the fundamental nanoscale properties but also for exploring the novel device applications by utilizing their unique and robust properties in air and/or water. Although the crystal phase variation of metal oxides, which exhibits the variety of physical properties, is an interesting feature compared with conventional semiconductors, it is difficult to control the crystal phase in the VLS nanowire growth of metal oxides. Here we show that a material flux critically determines the crystal phase of indium-tin oxide nanowires grown via VLS route, although only thermodynamical parameters, such as temperature and pressure, were previously believed to determine the crystal phase. The crystal phases of indium-tin oxide nanowires unexpectedly varied from the rutile structures (SnO_2), the metastable fluorite structures ($In_xSn_yO_{3.5}$) and the bixbyite structures (Sn-doped In_2O_3) when only the material flux was varied within an order of magnitude. This flux induced crystal phase variation can be interpreted in terms of the material flux dependences of crystal phases (rutile SnO_2 and bixbyite In_2O_3) on the critical nucleation at the liquid-solid interface. Thus, precisely controlling the material flux, which has been underestimated for VLS nanowire growths, is important to control the crystal phase and properties in the VLS growth of multicomponent metal oxide nanowires.



Reference: *Meng et al. J. Am. Chem. Soc. 135 (2013) 7033−7038*