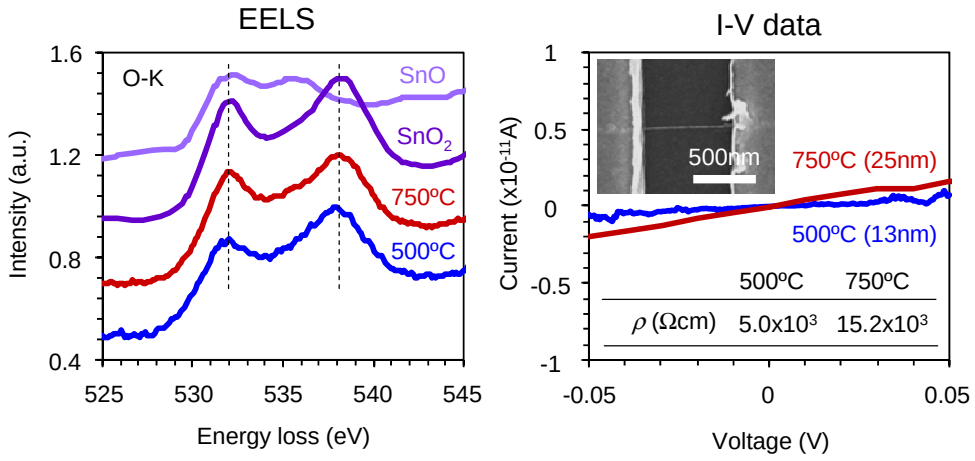
Optical and Electrical Properties of Low Temperature Grown VLS Oxide Nanowires via Material Flux Window Concept

Zetao Zhu[1], ○Kazuki Nagashima[1], Hideto Yoshida[3], Hiroshi Anzai[2], Daiki Sakai[2], Akihide Inoue[2], Chie Nakamura[2], Masaki Kanai[1], Yong He[1], Seiji Takeda[3] and Takeshi Yanagida[1,2]

[1]IMCE Kyushu Univ., [2]Eng. Sci. Kyushu Univ., [3]ISIR Osaka Univ.

E-mail: kazu-n@cm.kyushu-u.ac.jp

Vapor-liquid-solid (VLS) growth process of single crystalline metal oxide nanowires has proved the excellent ability to tailor the nanostructures. However, the VLS process of metal oxides in general requires relatively high growth temperatures, which essentially limits the application range. Here we propose a rational concept to reduce the growth temperature in VLS growth process of various metal oxide nanowires. Molecular dynamics (MD) simulations theoretically predicts that it is possible to reduce the growth temperature in VLS process of metal oxide nanowires by precisely controlling the vapor flux. This concept is based on the temperature dependent “material flux window” that the appropriate vapor flux for VLS process of nanowire growth decreases with decreasing the growth temperature. Experimentally, we found the applicability of this concept for reducing the growth temperature of VLS processes for various metal oxides including MgO, SnO_2 and ZnO. In addition, we show the successful applications of this concept to VLS nanowire growths of metal oxides onto tin-doped indium oxide (ITO) glass and polyimide (PI) substrates, which require relatively low growth temperatures. The optical and electrical characterization showed that the qualities of oxide nanowires grown at high (750°C) and low (500°C) temperatures are comparable when the oxide nanowires growth is strictly controlled by material flux window rule.



Reference: Z. Zhu *et al. Nano Lett.* 16, 7495-7502 (2016).