Lowering the Growth Temperature of Vapor-liquid-solid Oxide Nanowires

○Kazuki Nagashima[1], Zetao Zhu[1], Gang Meng[1], Masaki Kanai[1], Hiroshi Anzai[2], Fuwei Zhuge[1], Yong He[1] and Takeshi Yanagida[1,2]
[1]IMCE Kyushu Univ., [2]Eng. Sci. Kyushu Univ.
E-mail: kazu-n@cm.kyushu-u.ac.jp

Single crystalline oxide nanowires have potential interests in various application fields such as optoelectronics, energy harvesting/storage, and sensors due to their large surface-to-volume ratio, carrier transport without crystal boundaries, and chemical robustness in various environments. To extend the range of application, lowering the nanowire growth temperature is the most important issue. A vapor-liquid-solid (VLS) growth is well-known method to construct the single crystalline nanowire structure via a metal catalyst. However, the temperature of oxide nanowire growth has been determined via rule of thumb, and there were the technical limits for low temperature oxide nanowire growth in the VLS regime. Here we propose a rational design concept to realize the low temperature VLS oxide nanowire growth beyond the present technical limit. By extending the flux window rule [1], which can design the oxide nanowire growth by controlling material flux, the growth temperature can be arbitrarily designed by carefully controlling the material flux according to the temperature dependent equilibrium vapor pressures. We successfully demonstrate the reduction of VLS growth temperature less than 500 °C for various oxide nanowires such as MgO, SnO_2, ZnO. This general concept for designing the growth temperature gives us the tremendous opportunities to develop the nanodevice applications using well-defined single crystalline oxide nanowires.

References

[1] *Nano Lett.* 15, 6406-6412 (2015).

© 2016年 応用物理学会