

Single Crystalline NiO Nanowires Grown via VLS Mechanism and Their Significance on Resistive Switching Memory

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Vapor-liquid-solid (VLS) mechanism has been most widely used technique to fabricate one-dimensional single crystalline nanowires because of its controllability in size and position through a metal catalyst. Among various materials, metal oxide nanowires have been recently spotlighted due to their functionalities based on the unique electronic structure and ionicity. Conventionally, VLS grown oxide nanowires have been synthesized via empirical way. However, the kinds of available oxide nanowires are so far limited due to a lack of knowledge as to oxide VLS growth mechanism. Recently, we have theoretically and experimentally demonstrated the important role of vapor supply flux on the feasibility of conventional VLS oxide nanowire growth [1, 2]. Using a difference of nucleation event in VLS and VS growth, VLS nanowire growth can be enhanced by suppressing VS thin film growth. Here we demonstrate that our flux model can be applied to synthesize single crystalline NiO oxide nanowires. When the vapor supply flux is controlled carefully, NiO nanowires tend to emerge with the suppression of VS growth. Then the resistive switching memory characteristics of a single crystalline NiO nanowire are further examined. We found that the single crystalline NiO nanowire exhibits superior memory properties compared to conventional NiO polycrystalline nanostructure due to the absence of grain boundaries. Thus these results highlight that our theoretical model is applicable not only to understand the conventional oxide VLS mechanism but also to design the novel oxide nanowire growth. We believe that our methodology will pave the way to develop the novel unique nanodevices using various functional oxide nanowires.

References

- [1] Phys. Rev. E 83, 061606 (2011)
- [2] J. Phys. Chem. C 116, 24367 (2012)