Effect of Processing Conditions on the Evolution of Nanostructures in Oxide Semiconductors

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Abstract

As there are a large number of opportunities that might be realized by making new types of nanostructures, creation of nanostructures of various sizes and shapes are crucial toward realization of functional nanosystems. In this regards, a number of reports have described on zero-dimensional (0D) (quantum dots) and 1D (nanowires and nanotubes) nanoscale building blocks to date. Here, we report the effects of processing atmosphere and temperature on the evolution of various sizes and shapes in the wide bandgap oxide semiconductors. We synthesized various nanostructures of ZnO and SnO2, the typical wide bandgap semiconductors for optoelectronics, based on a simple carbothermal reduction process on an Au-coated silicon substrate under various atmosphere. By controlling the processing temperature and the atmosphere systematically, we could obtain various nanostructures such as combs, rods, rod arrays, and sheets in addition to the typical nanowires in ZnO. We also observed that the processing conditions are crucial parameters determining the density and diameter of the nanowires in SnO2 and ZnO. X-ray diffraction and transmission electron diffraction analyses together with photoluminescence analysis will be presented and discussed.