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Synthesis of metal oxide nanostructures for energy applications

Recently, more and more attention has been paid to the ZnO nanostructures for its potential applications such as gas sensor, RUV laser, light emitting diode, dye-sensitized solar cell (DSSC), etc. Among these applications, ZnO based DSSC has been extensively investigated because ZnO exhibit similar band gap with TiO₂, however, ZnO is much easier to fabricate into nanostructures to enlarge the surface area and has much higher electron mobility. Many methods have been developed for synthesizing ZnO nanostructures including chemical vapor deposition, hydrothermal method, sol-gel method and chemical bath deposition, etc. We had succeeded in developing a novel multiple-annealing method, which includes both the reducing reaction and oxidation reaction processes, to synthesize ZnO nanostructures on different transparent conductive oxide films at a low temperature. It was found that the substrates had significantly influence on vertical alignment of ZnO nanostructures. The lower mismatch of the lattice imperfection between ZnO film and substrates contributed to fabricating ZnO film with good crystallinity and well-aligned ZnO nanostructures. The annealing temperature contributed to the density and length of ZnO nanostructures. The surface morphology and the crystallinity of the ZnO nanostructures could be modified by a novel mist CVD method. In order to increase the conversion efficiency of DSSC, a designed photo anodes using vertically aligned ZnO nanostructures were applied to replace nano crystalline porous TiO₂ films. The pure anatase-structured-TiO₂ thin film was successfully coated on ZnO nanostructures to improve the stability by mist CVD method. As the result, the conversion efficiency of DSSC was significantly improved.

Biography

Chaoyang Li is currently a Professor at Kochi University of Technology, Japan. She had received her BSc degree in Physics and the MS degree in Microelectronics and Solid State Electronics from Heilongjiang University, China. She had also pursued her PhD degree in Electrical Engineering at the Kochi University of Technology, Japan. She has worked on the semiconductor growth, physics, processing and devices. She had also contributed to the hundreds of scientific international journals and international conferences. Her current research interests include nanotechnology, sensor and photovoltaic devices.

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