Wide Band Gap Metal Oxide Materials for Sensing and Renewable Energy Applications

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Recently, interest in sensors, which are an essential element in a variety of fields of optical and optoelectronic systems, has been increasing with the advent of the 4th industrial revolution era. Conventionally, Si/Ge- and III-V-based semiconductors have been employed for photo sensing applications. Meanwhile, to prevent global warming, it is necessary to take measures to reduce greenhouse gas emissions of developed countries and to secure alternative energy. Environment-friendly energy harvesting and energy storage researches are being actively carried out. Among the energy storage devices, supercapacitors have considered as a green and safe energy storage device because of their high power density, fast charge-discharge cycles and long cycling life. An effective method for increasing the capacitance is to develop the novel electrode materials such as transition metal oxides with versatile morphologies, high surface area and good electrochemical activity. Low-dimensional metal oxide-based semiconductor nanostructures, which are fabricated using simple and cost-effective processes by various methods, have many advantages such larger surface areas and superior properties over bulk or thin-film structures. These nanostructures have been applied to optoelectronic and energy devices to improve the device performance. In this presentation, the synthesis and properties of the metal oxide-based semiconductor nanostructure (e.g., ZnO, CuO, MnO, NiO, etc.) are reported for sensing and renewable energy applications. The morphologies and crystallinity of the fabricated nanostructures were investigated by scanning electron microscope/transmission electron microscope images and X-ray diffraction patterns, respectively. The optical and electrochemical properties were evaluated for these applications. These results can provide an insight into the fundamental understanding of the mechanisms in improving device performance by applications of metal-oxide semiconductor nanostructures in sensing and renewable energy devices.