Effect of Sb mole concentration on the electrochemical characteristics of electrodeposited Cuprous oxide thin film

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Cu2O, a p-type oxide semiconductor, has a high absorption coefficient and is a resource-friendly and eco-friendly material, so it can be used in various photoelectric devices such as a solar cell absorption layer and a water splitting photocathode. When the Cu2O thin film deposited by electrochemical deposition process which has advantages such as deposition on a large area, recycling of precursor, low cost facility, and low temperature deposition, in industrial and economic competitiveness can be advantageous over vacuum process. However, since the Cu2O thin film grown in atmospheric pressure and low temperature based electrodeposition method has lower conductivity than grown by the vacuum process. When the Cu2O absorption layer of the solar cell or the photocathode of water splitting is manufactured by electrodeposition condition, the efficiency of the device is inevitably lower than that of the vacuum process because the electrons and the holes are not effectively transferred by its high resistivity. Various methods such as optimization of the deposition method and application of the post-deposition process have been attempted to solve the problem of the conductivity of electrodeposited Cu2O film. In order to solve the existing problems, our team improved the preferential orientation of Cu2O thin film by adding Sb, which is a metal additive that can be controlled from the growth behavior, and improved the mobility of the thin film. This research focused on the optimization of conductivity of Cu2O thin film, optimized by controlling the amount of Sb.

Electrochemical deposition of Cu2O with Sb was carried out at the concentration of 1mM, 2mM, 3mM, 4mM and 5mM of Sb in Cu2O deposition bath. Linear sweep voltammetry graphs of each molar concentrations were obtained to confirm the effect of Sb on Cu ion consumption in effective potential during the deposition process. The structural and electrical properties of the deposited thin films were also analyzed by X-ray diffraction and current-voltage, and the carrier concentration and mobility characteristics of the thin films by various Sb molar concentration were measured by capacitance-voltage and impedance spectroscopy and the optimum film condition was confirmed.