Electrochemical Reduction of Carbon Dioxide to Alcohols on Perovskite-Type Electrodes

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The study of electrochemical carbon dioxide reduction to produce hydrocarbons is one of the interesting field of carbon dioxide recycling. Numerous papers have been published in connection with electrochemical reduction of carbon dioxide. They reported that methane, carbon monoxide, formate, ethane, ethylene and alcohols were selectively produced in the cathodic reduction of carbon dioxide on metal electrodes. Schwartz et al. have presented the results for electro- chemical carbon dioxide reduction to produce ethanol and n-propanol by using perovskite-type electrocatalysts.

In this work, we present the experimental results of the electrochemical carbon dioxide reduction to produce alcohols on perovskite-type electrodes, $La_{0.9}Sr_{0.1}CuO_3$, which contains copper in the perovskite B lattice site. The perovskite oxide was synthesized by the amorphous citrate sol-gel method. The electrochemical reduction of carbon dioxide was potentiostatically conducted by using an all-acrylic batch type electrolytic cell with the perovskite-type electrode in KOH electrolyte. Electrolysis product contained in liquid phase (electrolyte) were analyzed by Hewlett Packard 5890-II gas chromatograph equipped with a TCD/FID detector and HPLC(Waters model 510 pump) equipped with UV detector.

We obtained a series of i-V voltammograms of various temperature and electrolyte concentration. The pattern of i-V curve for the perovskite electrode showed a similar features in most conditions. Under the potential of -1.0 ~ -1.5 V vs. Ag/AgCl, current density was constant with potential change.

The electrochemical carbon dioxide reduction to produce acetaldehyde, methanol and ethanol is investigated by using perovskite type electrode ($La_{0.9}Sr_{0.1}CuO_3$). The highest faradaic efficiencies for methanol, ethanol, acetaldehyde were 11.6, 15.3, and 6.2%, respectively. The experimental data demonstrated that the capability of the perovskite type oxide for the electrode of electrochemical carbon dioxide reduction to produce alcohols was superior to other metal electrode.