Electrochemical Conversion of Carbon Dioxide Using Diamond Electrodes

Mai Tomisaki
International Institute for Carbon-Neutral Energy Research, Kyushu University

Carbon dioxide is considered as an abundant source of carbon and it can be converted into useful compounds by electrochemical reduction, photochemical reduction, or organic synthesis. Electrochemical conversion is a promising method because the reaction can be controlled easily by varying the applied potential or current, and it can be conducted at room temperature and ordinary pressure. As the reaction is conducted in an aqueous solution, hydrogen evolution reaction occurs as a competing reaction, so electrodes who do not easily generate hydrogen should be chosen. In this study, boron-doped diamond was used as the working electrode. It is a carbon-based electrode, and has high hydrogen overpotential, high durability, and potential to generate active species. The effect of electrolyte was investigated in detail by changing a supporting electrolyte and adding fine bubbles. Electrolyte consisting of large alkali metal cations and specifically adsorbed anions promoted the production of formic acid and suppressed the hydrogen evolution reaction. When perchlorate ions contained in electrolyte, carbon monoxide production was enhanced. Moreover, by using CO_2 fine bubbles in electrolyte, the decrease of overpotential and the promotion of carbon monoxide production was observed slightly. However, this reaction needs some improvement.

In addition, the usage of fine bubbles will be studied further to accelerate the reaction on diamond electrodes and the modification of catalysts will be also investigated to produce other CO_2 conversion species.

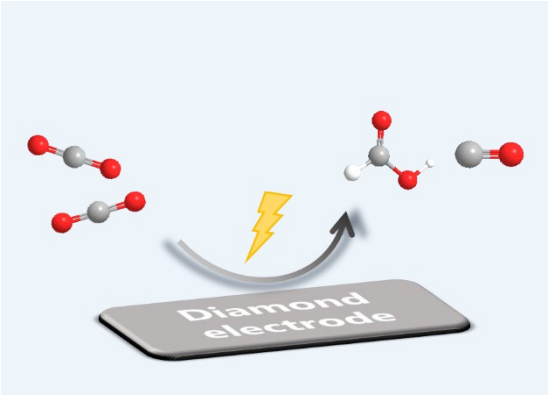

Fig. 1 Electrochemical reduction of carbon dioxide on diamond electrodes