

Diamond Nanotextures Decorated with Copper  
Nanoparticle for Efficient CO<sub>2</sub> Reduction  
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Electrochemical reduction of carbon dioxide into organic fuels is of both energetic and environmental importance. Because of the suppressed hydrogen evolution as well as high solubility of CO<sub>2</sub>, room temperature ionic liquid (IL) is the suitable solvent and electrolyte for this purpose. As for the electrode, boron-doped diamond will be excellent due to high overpotential for hydrogen evolution and long-term stability. Moreover, diamond nanotexture provides the surface enhancement which is critical for the realization of high efficient CO<sub>2</sub> reduction.

In this presentation, we introduce high efficient CO<sub>2</sub> reduction on diamond nanotextures decorated with copper nanoparticles in aqueous, non-aqueous (e.g. ILs) and the mixture of aqueous and non-aqueous solutions. Diamond nanotextures with density up to 10<sup>10</sup> cm<sup>-2</sup> and sizes from 30 to 500 nm were applied. Copper nanoparticles deposited wet chemically and electrochemically were applied with varied sizes of 10 to 1000 nm and the densities of 10<sup>10</sup> to 10<sup>8</sup>, resulting in a surface coverage of from 1.6% to 80%. The shape of copper nanoparticles was changed from cubic to round. Different ionic liquids (e.g. from bis(trifluoromethylsulfonyl)imide, trifluoromethanesulfonate, imidazolium, and pyrrolidinium) with different viscosities and conductivities were used. The electrochemistry of CO<sub>2</sub> on these electrodes in these solutions, especially in different ILs was investigated in detail. The variation of the densities and sizes of copper nanoparticles did not alter the starting potential for CO<sub>2</sub> reduction (-0.1 V vs. NHE). On a diamond electrode decorated with copper nanoparticles, CO<sub>2</sub> reduction starts from -0.1 V vs. NHE when a mixture of water and ionic liquid ([H<sub>2</sub>O] = 10 μM) is used. The current density reaches 5.1±0.1 mA cm<sup>-2</sup> for CO<sub>2</sub> reduction at a potential of -1.3 V vs. NHE. The products were analysed using high performance liquid chromatography-gas chromatography (HPLC-GC) at different potentials and before/after adding μM water. The conversion efficiencies will be estimated and compared with those shown in literature on other electrode systems.