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One-Pot Synthesis of Fe-N-Carbon by Solution Plasma Process and its Nanostructure Characteristic and Electrochemical Activity

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It is well known that Fe-N-Carbon as the alternative material offers the catalytic activity in the electrochemical cell, especially oxygen reduction reaction. In this study, the Fe-N-Carbon is synthesized by one-pot synthesis using solution plasma process (SPP). The selected N-carbon precursor plays an important role in the nitrogen content of the Fe-N-Carbon affecting to the catalytic activity. The N-containing organic solvents, including pyridine, aniline, pyridine/aniline, and pyridine/triazine are used as the precursors. The discharge process under controlled conditions with the Fe rods as electrode is accomplished to obtain Fe-N-Carbon. The as-synthesized Fe-N-Carbon is stepwise heat-treated at 900 °C for removing the residual organic solvent and ordering the nanostructure. The nitrogen content collected from elemental analysis shows that the Fe-N-Carbon produced using pyridine/triazine has the highest percent of nitrogen at about 15 and 5% of as-synthesized Fe-N-Carbon and heat-treated Fe-N-Carbon, respectively. The transformation from amorphous nanostructure to nanocrystalline graphite of Fe-N-Carbon after heat treatment and the presence of Fe nanoparticles with average size about 7 nm are confirmed by X-ray diffraction measurement and transmission electron microscope. From the results of static cyclic voltammatry, moreover, Fe-N-Carbon exhibits the strong potential of ORR under the saturated O_2 condition.