VIII-Q Effects of High Magnetic Field on Chemical Process

It is interesting to control chemical and physical process with the aid of magnetism which is one of the key properties of matter. This research group is studying the mechanisms of the interaction of matter and magnetic field in order to develop a new technique to control chemical and physical process by magnetic field. In the anodic oxidation reaction of potassium iodide, significant magnetic field effects (≤ 0.6 T) on the product yields are interpreted in terms of the Lorentz force on idode ions. In the liquid/solid redox reaction of silver ion and copper metal, anomalous magnetic field effects (≤ 15 T) are chiefly explained by the magnetic force on generated copper ions. It is clarified that mass transportation in solution is remarkably affected by the magnetic field.

VIII-Q-1 Magnetic Field Effects on Anodic Oxidation of Potassium Iodide

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[*Bull. Chem. Soc. Jpn.* in press]

External magnetic fields (≤ 6 kG) significantly increase yields of I_3^- and H_2 as well as anodic currents in anodic oxidation of potassium iodide. At 0.7 V, the ratio of the current at 6 kG and at 0 kG is about 1.7, whereas that of I_3^- yield is 1.2. The ratio of the H_2 yield is 1.4 at 2 kG. The Lorenz force on ions in the solution induces convection of solution (MHD flow), resulting in acceleration of the entire reaction rate. The MHD flow of the solution is confirmed from the visual observation that reddish-brown streams of I_3^- in the solution, moving downward at zero field, undergo turbulent motion in magnetic fields. Small magnetic field effect on the I_3^- yield, compared to that on the anodic current, is attributable to the fact that the reaction of I_3^- and OH^-, generated at the cathode, is also enhanced by the MHD flow.

VIII-Q-2 High Magnetic Field Effect on the Growth of 3-Dimensional Silver Dendrites

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[*Chem. Lett.* submitted]

A liquid/solid redox reaction between silver ion and copper metal is investigated under high vertical magnetic field (maximum field strength: 15 T). The magnetic field causes drastic changes in the color and shape of silver dendrites. At zero field, branches of metallic silver grow on the gray and cylindrical dendrites. In the presence of magnetic field, the dendrites are black in color and almost spherical in shape. The dendrites in magnetic field are denser than those at zero field. In the presence of the magnetic field, yields of silver dendrite and copper ion increase by 1.3–2. These effects are chiefly interpreted in terms of the magnetic force in copper ion in solution. As the reaction progresses, paramagnetic copper ions are generated. These ions are attracted by the magnetic force, leading to the convection of the solution.