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Magnetic Field Effects on Lead Metal Deposition

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Earlier, we investigated the magnetic field effects (MFE) on electroless metal deposition by ionization tendency. We studied MFE on silver dendrite from the reaction of copper metal and silver nitrate solution and on copper metal deposition from the reaction of zinc metal and copper sulfate solution. These results were interpreted in terms of magnetic force acting on paramagnetic copper ion intervening in the reaction [1]-[3]. In this study we examined the effect of a magnetic field (0.38 T) on electroless lead metal deposition from the reaction of a lead(Ⅱ) acetate aqueous solution and a zinc metal, where no paramagnetic species intervened.

$$Pb^{2+} + Zn \rightarrow Pb \downarrow + Zn^{2+}$$

The reaction of the lead metal deposition was varied on the lead (Ⅱ) acetate concentration (0.1~0.5 mol/L). The reaction in 0.2 mol/L and 0.5 mol/L lead (Ⅱ) acetate solution, the reaction yield were increased and the reaction rate were accelerated by 0.38 T magnetic field. On the other hand, the reaction rate was decelerated by magnetic field in 0.1 mol/L solution (Fig. 1).

The deposited metal showed two type of crystallinity, high and low. The crystallinity was high in 0.2 mol/L, low in 0.5 mol/L, and both of high and low on one plate in 0.1 mol/L lead (Ⅱ) acetate solution. And low crystallinity area in 0.1 mol/L reaction was expanded by 0.38 T magnetic field (Fig. 2).

In this reaction, no magnetic force was operative because no paramagnetic species intervened. These MFE were explained by the convection by Lorentz force and the reaction rate limiting step varied by solution concentration.

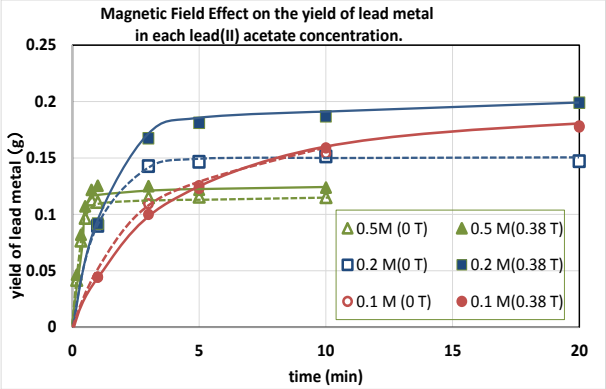

Fig. 1 Magnetic field Effect on the yield of lead dendrite in each lead(II) acetate

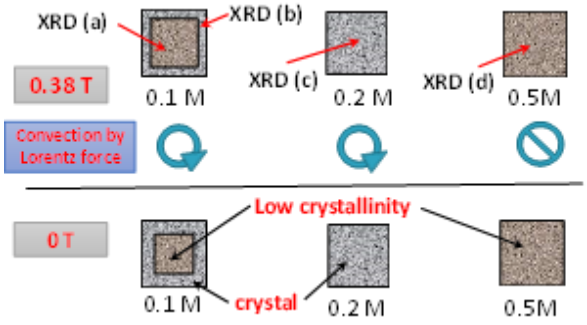

Fig. 2 Magnetic field Effect of lead (II) acetate concentration on morphology of deposited

[1] Katsuki A., Uechi I., Tanimoto Y., *Bull. Chem. Soc. Jpn.*, **77**,275-279 (2004).
[2] Tanimoto Y., Udagawa C., Katsuki A., Maki S., Morimoto S., *Bull. Chem. Soc. Jpn.*, **86**, 1447-1449 (2013).
[3] Udagawa C., Maeda A., Katsuki A., Maki S., Morimoto S., Tanimoto Y., *J. Phys. Chem. B*, **118**, 4889-4894 (2014)
[4894 (2014)