Innovation of "Copper to Silver to Gold - The Alchemist's Dream" Using Aluminum Foil and Anionic Surfactant

Kishi, Yuka (School: Otsumaranzan High School)

An experiment in which a copper plate is zinc-plated and then heated to brass plating is known as the "Alchemist's Dream." With the conventional method, there is a risk of bumping and scattering of NaOH, and ignition of zinc powder after the experiment. In the present research, I have developed a new method to obtain uniform and beautiful brass plating in highly safe condition. The experimental condition is simple. A copper plate is zinc-plated at room temperature by placing on aluminum foil in a plating buffer solution (pH 4) containing 2.0 mol/L $ZnCl_2$ aq. and an anionic surfactant, sodium dodecyl sulfate (SDS). Then, it is led to brass plating by heating with a gas burner. The advantages of this method are as follows. (1) The cause of the non-uniform precipitation of zinc generated in the plating solution under acidic conditions is the adhesion of dihydrogen bubbles to the copper plate. This undesired phenomenon can be prevented by adding SDS in a weak acidic solution. (2) The risk of zinc powder ignition was avoided by using aluminum foil. In addition to optimizing the experimental conditions of brass plating, I analyzed the reaction rates and mechanism using an electrochemical method. The new and simple electroless plating and alloying method found in this research can greatly improve the safety and the success probability of experiments of the "Alchemist's Dream" conducted around the world. As for the application, the combination of plating and alloying is expected to be employed to enhance the beauty and corrosion inhibition of metal surfaces. The present study may contribute to making this composite technology wider and more valuable.