Electrodeposition of Zn-Sn alloy from moisture stable ionic liquids on steel substrate

Guizhi Zeng[1*], *Andreas Moebius*[2], *Christoph Werner*[2], *Bernd Friedrich*[1]

[1] *IME Process Metallurgy and Metal Recycling, RWTH-Aachen University, Intzestrasse 3, 52056, Aachen, Germany*
[2] *Enthone GmbH, Elisabeth-Selbert-Strasse 4, 40764 Langenfeld, Germany*

Guizhi Zeng: gzeng@metallurgie.rwth-aachen.de

Ionic liquids have received intensive attention in the last decades for electrochemical applications and more specifically for the electrodeposition of metals, due to their excellent chemical and electrochemical properties. A new type of a deep eutectic solvent based on choline chloride possesses not only the properties of conventional ionic liquid but also a good stability under air and moisture.

Zn-Sn alloys have been widely employed to protect steel and similar metallic materials from corrosion or to improve the solderability of the metals. A variety of aqueous baths ranging from alkaline-cyanide to acid for electroplating of Sn-Zn alloy have been reported, but the study of the electrodeposition behaviour of Zn-Sn alloy from ionic liquids is just underway.

In this work, the electrodeposition of Zn-Sn alloy on steel substrate from a moisture stable ionic liquid based on deep eutectic mixture of choline chloride (ChCl) and ethylene glycol (EG) has been investigated, as well as the influences of plating conditions, such as bath composition, current density, plating temperature, and stirring conditions, on the Zn-Sn coating composition and cathodic current efficiency. The results show that uniform Zn-Sn deposits with a wide range of Sn content can be electrodeposited from the ChCl-EG based electrolyte bath. The best qualified zinc-tin deposits with homogeneous distribution of alloy composition (around 20%Sn) and high cathodic current efficiency can be obtained from the used electrolyte containing a high molar ratio of Zn:Sn. The Sn content in the deposits increases with decreasing Zn:Sn ratios in electrolyte. Increasing the cathodic current density, the Sn composition of the deposited coating will be decreased, while the cathodic current efficiency will be decreased. With higher plating temperatures, the Sn content in the alloy coating will increase, the cathodic current efficiency decreases, and the alloy composition becomes more dependent on the current density. Weak stirring forces the deposition of Sn.

Key Words: ionic liquids, Zn-Sn alloy, deep eutectic solvent, electroplating