Aluminization Process From Ionic Liquid in Operative Conditions: Validation and Perspective

A. Giaccherini[1], E. Berretti[2], S. Martinuzzi[1], S. Caporali[1]

[1]INSTM, Firenze, Italy
[2]Department of Chemistry, University of Florence, Firenze, Italy

Abstract

In the last years a growing interest was manifested for ionic liquids (ILs) as electrolyte, they offer a variety of advantages over aqueous electrolytes. In general ILs show large chemical and thermal stability, high ionic conductivity and an electrochemical window much larger than water. Thus enabling the effective electrodeposition of some very non-noble metals, such as Al, Nb and Ti. Still, the use of ionic liquids as electrolyte constitutes a challenging quest for galvanic industry due to their peculiar transport proprieties. Obtaining a smooth film with high deposition rates is a difficult task for Ils base process, due to their peculiar transport proprieties, a careful design of the galvanic process is required. We recently developed a complete FEA model suitable for the description of a very specific electrodeposition process of Al from BMIMCl/AlCl3(1:1.5). This work aims to validate this model at a lab scale in operative conditions under stirring and at different temperatures. We implemented a 3D simulation of the velocity field in a typical beaker stirred by means of a magnetic stir bar. Two different systems have been modeled, the experimental Ils based process and a hypothetical process from aqueous solution. The experimental setup implies very low Reynolds number for the flow in the IL due to its high viscosity. Conversely the flow in water is characterized by high Reynolds number. Consequently, we performed CFD simulation with laminar flow for IL and with a k-ϵ turbulence model for water. The resulting advection field is used to simulate the tertiary current distribution in the electrodeposition process. Eventually we present a comparison of the computed thickness distribution with the experimental. A critical analysis of the differences between IL based process and the hypothetical water based process allows to rationalize the effect of the transport properties on the thickness distribution in different operative conditions.

Figures used in the abstract

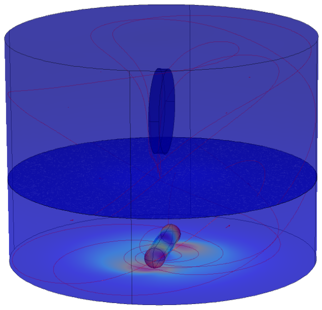

Figure 1: 3D velocity field in the electrolyte stirred by a magnetic bar.