Influence of a Chip Holder for a Silicon Cathode in Electrodeposition Processes Using a Hull Cell

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Abstract

Introduction: Electrodeposition has a major advantage over other methods of thin film deposition. It allows one do it at atmospheric pressure and room temperature, requiring relatively inexpensive equipment. [1] The Hull cell is a miniature electrodeposition tank where the cathode is angled with respect to the anode. The resulting current density will vary along the length of the cathode surface. [2] That way, it is possible to obtain an optimal plating distance for certain given parameters of the system. There are, normally, practical problems if a semiconductor cathode is used. A full back-contact has to be provided to avoid different deposition rates due to the high resistivity of a doped semiconductor substrate compared to a metal cathode. Furthermore, an electrical non-conductive holder is used to prevent deposition other than through the front opening where the cathode has its interface with the electrolyte. It is expected that the current lines in the plating cell will be changed and trying to minimize that the holder opening for the cathode was made as central and as large as possible. Use of COMSOL Multiphysics: 2- and 3-D electrodeposition finite element simulations of a 250 ml Hull cell with soluble copper anode were done to obtain the current density along the cathode surface. The silicon chip holder is also added to the simulations in order to analyze its influences to the experiment. Results: The electrolyte current density vectors inside the Hull cell are shown in Figure 1. After normalizing the results from the simulation [3] a comparison is shown in Figure 2. The current density vectors for the Hull cell using the chip holder can be seen in Figure 3. Conclusion: The experiments with the Hull cell and the chip holder were realized and the simulations have shown similar results. A modified Hull cell design will be suggested for further experiments. The simulation of the new setup will also be shown.

Reference

[1] A. A. Pasa, W. Schwarzacher, “Electrodeposition of Thin Films and Multilayers on Silicon”, Phys. Stat. Sol. (a) 173, 73, 1999.
[2] N. Kanani, “Electroplating: Basic Principles, Processes and Practice”, 1st Edition, Elsevier, 2006.
[3] Deutschen Normen, “Galvanisierungsprüfung mit der Hull-Zelle”, DIN 50957, 1978.

Figures used in the abstract

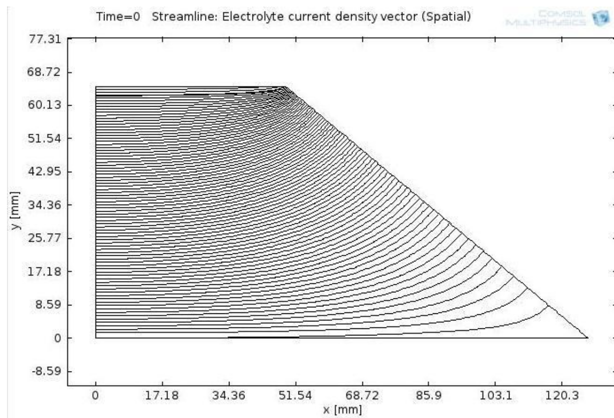

Figure 1: 250ml Hull cell current density.

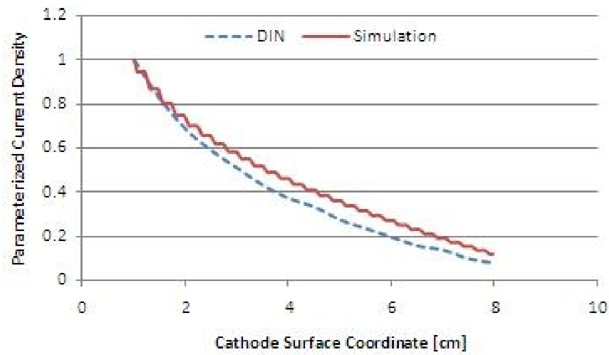

Figure 2: Parametrized current density along the cathode.

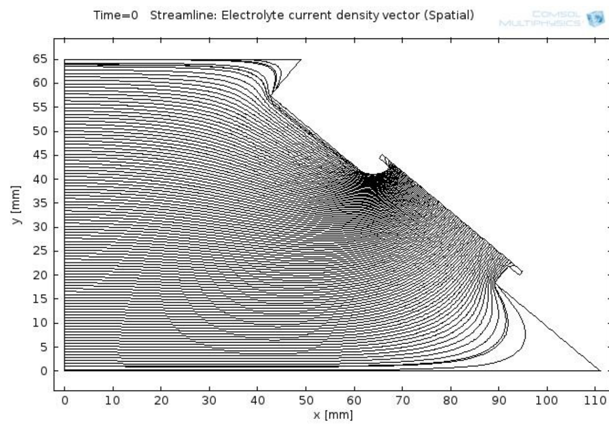

Figure 3: 250ml Hull cell (with chip holder) current density.