Maskless Electrochemical Micropatterning on Substrates

QiBai Wu, T. A. Green and S. Roy

School of Chemical Engineering and Advanced Materials (SCEAM)
Institute of Nanoscale Science and Technology (INEX)
Newcastle University, Merz Court
Newcastle upon Tyne, NE1 7RU, U.K
E-mail: s.roy@newcastle.ac.uk

Microfabrication is a key technology in a variety of industries. In a typical microfabrication process, micro scale pattern transfer is achieved by photolithography technology using mask and resist. Our work relates to a novel technique which allows microfabrication without resorting to photolithography on substrates. We have developed an electrochemical process to transfer micro scale patterns on a fully exposed (un-patterned) metallic bulk substrate through a specialised electrochemical reactor. And we have obtained etched substrates with micro scale pattern with good reproducibility.

In this presentation we report our current work on electrochemical maskless micropatterning by plating on substrates. During the electrochemical plating, a metallic substrate with a resist pattern serves as an anode and the fully exposed substrate is a cathode. The two electrodes are placed facing each other within close proximity. Electrolyte is pumped through the system to deliver fresh solution to the anode and cathode as well as remove reaction by-products.

Copper is selected as plating material in our initial experiments. The results show that copper micro scale patterns could be directly deposited on metallic substrates. Surface morphology, roughness, width and thickness of copper deposits have been determined. The effect of applied current density and deposition time were investigated in detail. Since a single anode could be used to produce more than ten cathodes with micropatterns, this procedure decreased photolithography by 90%.