SIMULATION AND MODELING: GENERATION OF STRUCTURED SURFACES USING PULSE PLATING

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The creation of structered metallic surfaces in the micrometer range (5-20 µm in broadness, up to 15 µm in thickness) by galvanostatic deposition processes can be done using pulse plating techniques. Since the parameters of such techniques, e. g. pulse length, pulse height, reverse pulses etc. create a multidimensional matrix of variables. An experimental optimization-procedure needs a long time and a lot of experiments. Modeling techniques offer here an excellent tool for a basic understanding and a much faster optimization procedure of the process. As an example, the deposition of copper deposition structures using acid electrolytes are presented.

Supposing the convection is dominant and concentration gradients are neglectible, the spatial potential field is determined by the Laplace equation and the so-called Potential model can be used to evaluate the current density distributions. In this contribution, a special simulation software [1] is applied which is based on the Potential model in order to study the deposition profile on an active electrode surface with masks.

Using an appropriate parameter set (determined by experimental techniques like RDE or impedance measurements) the growing of the deposit can be calculated. Using a classical DC galvanostatic process, the deposit within a mask growth as shown in Fig. 1.

Since, in general, the development of a concave-shaped deposition profile is desired, one has to find out a method to influence the shape of the deposit. It will be demonstrated that this problem can be solved by using pulse plating techniques instead of DC-deposition.

The basic idea consists in choosing the cathodic current density (CCD) and the anodic current density (ACD) in such a way, that the ACD is more primary then the corresponding CCD. As a consequence, the material accumulated at the edges of the mask during the cathodic treatment is efficiently removed by anodic dissolution. A concave curvature can be designed by using properly chosen pulse-parameters (Fig. 2).

For a further optimization process, based on the real polarization curves of the system, parameters like CCD and ACD, length of the cathodic and anodic pulses and the equilibration time, have to be varied within the modeling procedure and fitted with respect to special requirements.

As a further extension of the modeling technique, the Navier Stokes equation has to be solved to take into account effects of convection and stirring processes. Some results will be discussed.

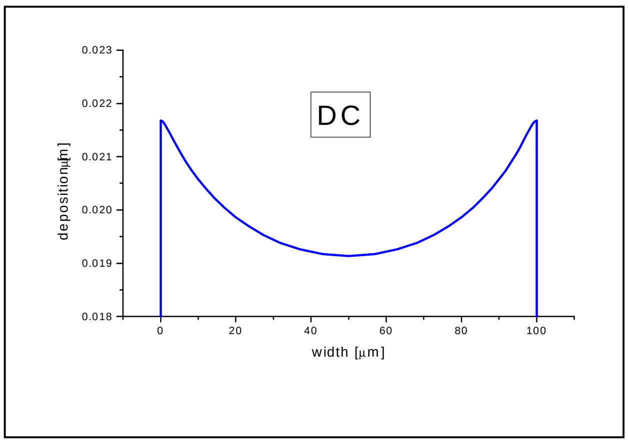

Fig. 1. Calculated shape of a conducting line deposited by DC-current, width of the mask 100µm.

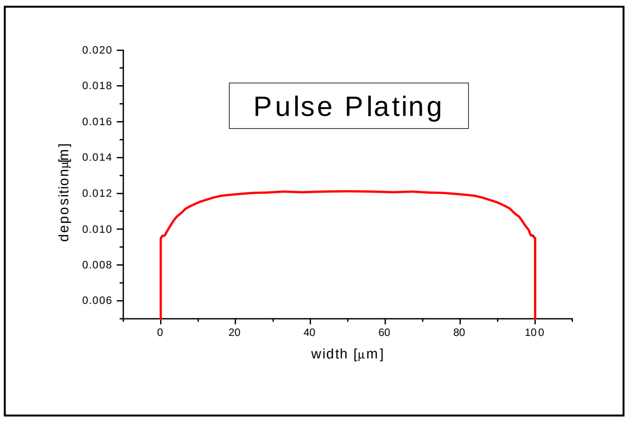

Fig. 2. Calculated shape of a conducting line of copper using a pulse plating procedure (width of the mask 100µm).

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