MICROSTRUCTURED ELECTRODEPOSITION OF COPPER USING PULSE PLATING

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In the last decades there is an increasing interest in copper deposition, mainly in the microelectronics industry. The requirements for those deposits like a more uniform thickness distribution, less roughness and porosity of plated copper are more demanding and forced to look for new techniques (see Fig. 1 and 2).

In many cases these properties of the metallic deposit can be selectively influenced and drastically improved by the application of pulsed current or pulse reversed current plating. For practical work, an acid copper sulphate bath without additives has been used. The investigations were supported by electrochemical simulation of the deposition process in dependence of different parameters like viscosity, exchange current density, double layer capacity, conductivity and diffusion coefficients of the copper and chloride ions. As a result of these simulation one obtains the ion concentration and potential profile over the electrode domain near the electrode. Providing these data sets to an additional simulation program it is even possible to calculate the current density, the potential and concentration distribution (see fig. 3 and 4). The computer-assisted optimisation of the process parameters (t_{on}/t_{total}, j_{cath}/j_{an}, t_{off}, frequency turned out to be a valuable tool for the prediction of experimental results, which reduces the amount of necessary practical investigation.

By using pulse and reverse pulse plating for the production of electrodeposited copper layers, it is possible to obtain deposits with much more optimized properties than using DC plating, by adjusting the parameters of the pulse program. In this way, it is possible to produce layers for many different applications meeting strict requirements by influencing the micro- and even nano-structure of these deposits.

Acknowledgement
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Literature

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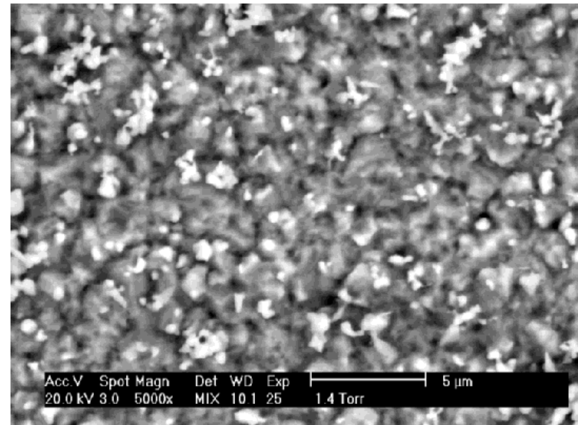

Fig 1.:ESEM picture showing a dendritic deposit. Magnification: 5000x

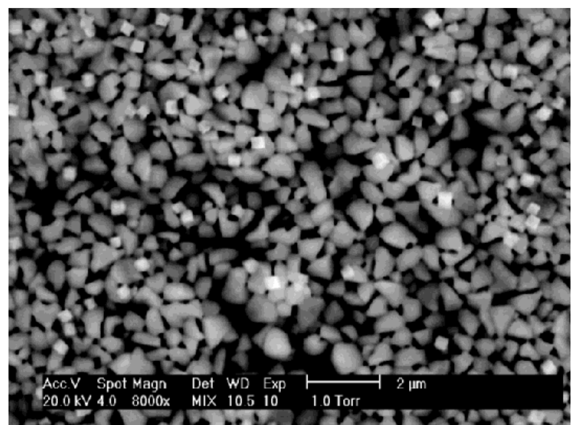

Fig. 2: ESEM picture of a deposit with small crystals obtained with an optimized pulse program. Magnification: 8000x

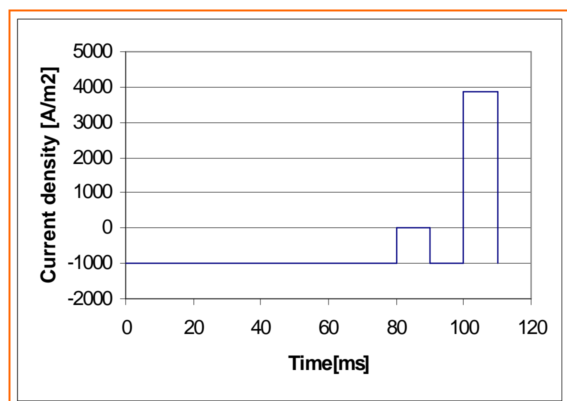

Fig. 3: Example of Pulse Program used for the copper deposition.

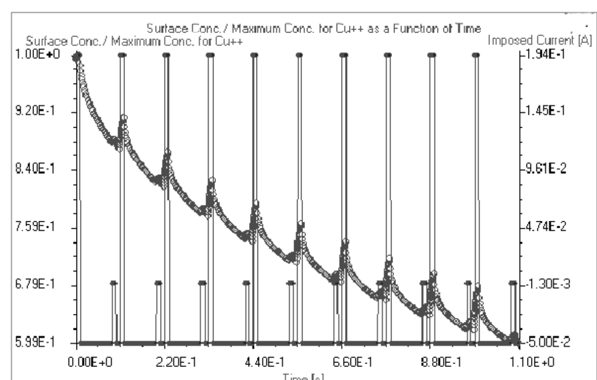

Fig. 4: Computer assisted simulation using the Pulse Program represented in Fig. 3