THE EFFECT OF HIGH MAGNETIC FIELDS ON THE ELECTRODEPOSITION OF METALS

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Cu and Co were deposited from pure sulphate electrolytes with different metal concentration under superimposition of vertical magnetic fields up to 13 T. Different orientations of the magnetic field to the electrode surface and electrode geometries were investigated by cyclic voltammety and potentiostatic measurements. If the magnetic field is oriented parallel to the electrode surface, a significant increase of the current density starts above from 100 mT after exceeding a threshold of about 100 mT. The threshold dependsand in dependence on the metal ion concentration. This deposition behaviour is mainly attributed to the forced convection generated by the Lorentz force. Other magnetically induced forces should be negligible. In the case of a magnetic field oriented perpendicular to the electrode surface the change of current density starts with a decrease or with oscillations followed by a strong increase at fields higher than 2 T. The change of the current density and the current efficiency depends strongly from the electrode geometry. Edge effects are very often underestimated. In the case of flat embedded electrodes the behaviour is determined by the Lorentz force generating a rotating flow at the edge of the electrode due to a gradient of the electric field. The deposition behaviour at electrodes with minimized edge effects is mainly determined by additional driving forced caused by a gradient of paramagnetic ions in the vicinity of the electrode. At higher magnetic fields this paramagnetic force induces an additional driving force. towards the electrode. The limited current density increases too but it leads to an decease of the current efficiency for the cobalt deposition. The measured effects are discussed in terms of different magnetically induced driving forces.

REFERENCES

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