

MHD-TRANSFER FUNCTION APPLIED TO METAL ELECTRODEPOSITION

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A sine-shaped modulation of the magnetic field applied in the close vicinity of a potentiostatically-controlled electrode gives access to the magnetohydrodynamic (MHD) transfer function $(\partial I/\partial B)_E$ that has proved fruitful for the study of several electrochemical systems governed by mass-transport. We present here other applications for the case of nickel and zinc electrocrystallization, together with some new results concerning silver electrodeposition from nitric and tartaric media.

Zinc electrodeposition in basic media

Under a potentiostatic regulation, the MHD transfer function allows the mass transport only to be analyzed (Fig.1). The experimental results are similar to that previously reported [1] and are in agreement with the corresponding theory. The comparison of the model to experimental data allowed the diffusion coefficient of $Zn(OH)_4^{2-}$ ions to be determined.

Nickel electrodeposition

In the case of nickel electrodeposition from a Watts bath, the presence of small amounts of organic inhibitors modifies dramatically the amplitude of the MHD transfer function (Fig.2). This dynamic investigation leads to understand the observed modifications that are provoked by the presence of the magnetic field both for the stationary current and the surface morphology [2].

Silver electrodeposition from tartaric and nitric solution

In Fig.3, we have represented in the Nyquist plane the MHD data measured for different polarisation potentials. A high frequency branch, followed by a typical mass transport loop in the low frequency domain, is obtained. For a given magnetic field, the amplitude of the high frequency response is regularly modified by both the polarisation potential value and the magnetic field intensity. This behaviour, somewhat peculiar, may be due to the charge distribution at the interface [3].

REFERENCES

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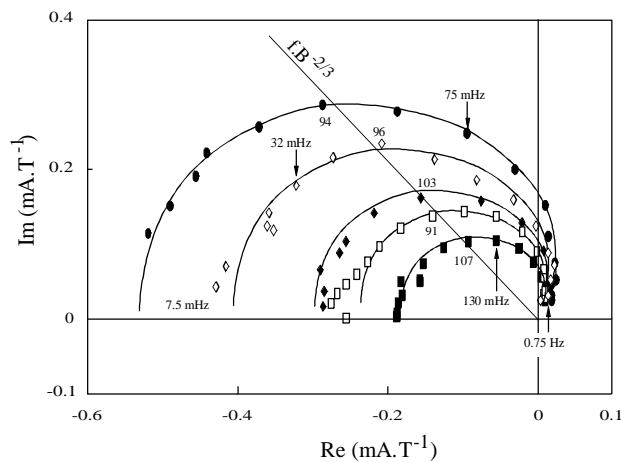


Fig.1 - Experimental MHD transfer function measured at the zinc electrodeposition limiting current. (●) $B = 0.3$ T, (◇) $B = 0.45$ T, (◆) $B = 0.6$ T, (□) $B = 0.75$ T, (■) $B = 0.9$ T. $[Zn(II)] = 0.2$ M, $[KOH] = 7$ M.

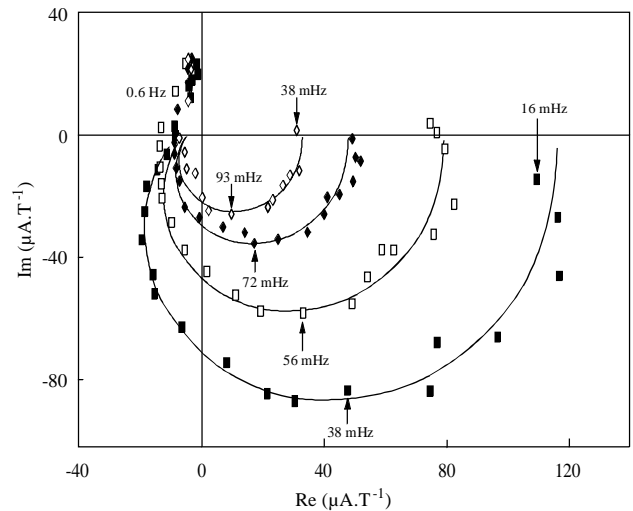


Fig.2 – MHD transfer $(\partial I/\partial B)_E$ function for nickel electrodeposition from a pure Watts solution $E_p = -880$ mV/SCE. (■) $B = 0.3$ T; (□) $B = 0.45$ T; (◆) $B = 0.6$ T; (◇) $B = 0.75$ T

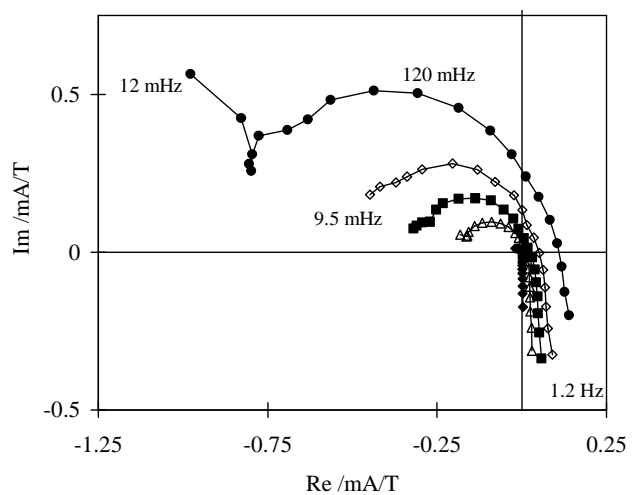


Fig.3 - Experimental MHD transfer functions $(\partial I/\partial B)_E$ measured at $B = 0.6$ T, for different E_p values: (◆) $E_p = -40$ mV; (△) $E_p = -70$ mV; (■) $E_p = -90$ mV; (◇) $E_p = -110$ mV & (●) $E_p = -150$ mV