Design of corrosion-resistant absorbers with a core @ dense film structure based on the "dissolution-redeposition" theory

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Abstract Chemical stability is the key factor of magnetic metal powder absorbers for their practical applications in the marine environment. The purpose of this work is to provide guidance for the controllable improvement of the chemical stability of powder absorbers to achieve the goal of integrated materials for microwave absorption and corrosion protection. Herein, a strategy of phosphating conversion coating (PCC) preparation based on the "dissolution-redeposition" theory which can regulate the surface dissolution reaction and deposition process of metal powder absorber was constructed reasonably. The TA/pH value of the phosphate conversion solution could be adjusted to reduce the hydrogen evolution rate and increase the nucleation rate of $CaHPO_4$ to prepare compact PCC with a certain thickness on the surface of iron powder. Results show that among the different samples, the sample fabricated in TA/pH=11.37 solution has the best corrosion resistance with the lowest corrosion current density (I_{corr} = 0.12 μA/cm^2) and the highest corrosion potential (E_{corr} = -0.453 V) due to the excellent compactness of PCC, and best microwave absorption performance due to the retained conductivity loss and improved impedance matching of the relatively thin thickness of PCC. The minimum reflection loss was −51.31 dB at 16.6 GHz and the effective bandwidth (RL < -10 dB) up to 5.4 GHz with a matching thickness of 2.28 mm.
Keywords Phosphate conversion coating, TA/pH, Anticorrosion, Microwave absorption

Reference

[1] M.R. Enikeev, D.I. Potemkin, L.V. Enikeeva, A.R. Enikeev, M.A. Maleeva, P.V. Snytnikov, I.M. Gubaydullin, Analysis of corrosion processes kinetics on the surface of metals, Chem. Eng. J. 383 (2020).
[2] X. Jiang, L. Zhang, L. Yin, G. Yang, J. Xie, L. Zhang, H. Lu, D. Liang, L. Deng, Corrosion behavior of fluorinated carbonyl iron-hydrophobic composites in neutral salt spray environment, Corros. Sci. 210 (2023).