Electrochemical Investigation of the Synergistic Effect Between Molybdate and Tungstate on Surface Passivation of Carbon Steel

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The purpose of this paper was to understand the synergistic effect between molybdate and tungstate for the surface passivation of carbon steel, particularly to find the optimum ratio of molybdate and tungstate. For Q235 carbon steel in mixed Na₂MoO₄ and Na₂WO₄ solutions with different ratios of MoO₄²⁻ and WO₄²⁻, the electrochemical methods, including potentiodynamic polarization, Mott-Schottky and electrochemical impedance spectroscopy (EIS), were applied. Under the total concentration of 0.2 mmol/L, the ratio variation of MoO₄²⁻ and WO₄²⁻ did not affect the corrosion behavior of Q235 carbon steel, and the main corrosion parameters, including corrosion potential (E_c), corrosion current density (i_c), flat band potential (U_f) and inner-layer passive film resistance (R_i) were independent of the ratio variation; however, the ratio variation of MoO₄²⁻ and WO₄²⁻ affected the passivation behavior of Q235 carbon steel obviously, and the main passivation parameters, including transpassive potential (E_t), donor density (N_D) and outer-layer passive film resistance (R_o), presented the optimum level when the ratio of MoO₄²⁻ and WO₄²⁻ was one to one. At the same time, the related mechanisms of corrosion and passivation were also discussed.

Keywords: carbon steel; molybdate (MoO₄²⁻); tungstate (WO₄²⁻); surface passivation; synergistic effect; electrochemistry

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