Corrosion behavior of Cr/RE alloyed rebar in carbonated simulated concrete pore solutions with chloride ions

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Abstract The objective of this study is to investigate the corrosion resistance of low alloy steel rebars co-modified with Cr/RE in simulated concrete pore (SCP) solution under the joint action of carbonation and chloride salts. This study investigated the effect of the addition of Cr and RE microalloying regarding the steel rebar's resistance to corrosion in the co-existence of carbonation and chloride ions using electrochemical tests, scanning electron microscopy and confocal laser scanning microscopy. The best corrosion resistance of the Cr/RE microalloying rebar was found by the reduction in corrosion rates and the diminution of the rust layer. And In chlorine-containing simulated concrete pore solutions with varying pH levels, the corrosion rate follows the regularity HRB400-Cr-RE>HRB400-Cr>HRB400. During the initial stages of localized corrosion, the depth and K value of the corrosion pits was minimized, which indicating the addition of Cr/RE improved early resistance to pitting. Additionally, XPS analysis revealed that Cr/RE microalloying rebar can change the structure of the surface oxide film with a higher Fe(II)/Fe(III) ratio, confirming an enhancement in the structure of the passive film. In conclusion, the mechanism by which Cr/RE microalloying improves corrosion resistance involves grain refinement and the formation of Cr/RE oxides, which are enriched on the surface of the rebar in the SCP solution with severe carbonation (pH=9.6). This enrichment leads to the formation of a denser passive film.

Keywords: Rebar; Carbonization; Passivation; Corrosion resistance.