Al, Cu-induced Enhancement in Marine Anti-biofouling and Anti-corrosion Resistance of High-entropy Alloys

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Abstract: Marine biofouling and microbiologically influenced corrosion, caused by a wide variety of microorganisms and corrosive species, have been multi-trillion-dollar-a-year problems. The development of multi-functional materials to tackle those challenges has been a long-standing quest in marine services. Aluminum-based high-entropy alloys (HEA) are promising engineering materials, however, their applications are limited given the poor anti-corrosion resistance in marine environments. Herein, we designed $Al_xCoCrCuFeNi$ HEA (x = 0, 0.1, 0.3, and 0.5, molar ratio) with superior marine anti-biofouling and anti-corrosion performance. The effects of Al contents on the $Al_xCoCrCuFeNi$ corrosion resistance were unveiled by analyzing microstructure, antibiofilm properties, antifouling properties, and passive film. The effect of released copper ions leads to minimizing adherence of biofilms upon the material surfaces. In particular, $Al_{0.3}$HEA exhibits the highest corrosion resistance, owning to an Al_2O_3-Cr_2O_3 enriched passive film to hinder the dissolution of the passive film. This work provides a systematic strategy for anti-biofouling and anti-corrosion HEA materials that can serve a great range of applications in marine engineering.