

Development of a Novel Cobalt High-Entropy Alloy for Wear/Corrosion Resistance

Abstract

In this research, a novel high-entropy alloy (HEA) having the equiatomic Co-Cr-Fe-Ni composition with high W (>18 wt pct), low C (<1 wt pct) and minor Mo contents, is created by combining the features of HEA and Stellite alloy, which is designated as HE6. The bulk specimens of HE6 are fabricated from the alloy powder via spark plasma sintering (SPS) or plasma transferred arc (PTA) welding process. The microstructural analyses using SEM/EDX/XRD reveal that HE6 has a microstructure consisting of diverse carbides and intermetallics embedded in a solid solution matrix which is constituted with multiple element FCC structures. The hardness and dry-sliding wear tests show that HE6 does not perform as well as Stellite 6 which is the benchmark of Stellite alloys. Under the electrochemical and immersion corrosion tests in hydrochloric acid and sulfuric acid, HE6 displays passivation ability by forming protective Cr oxide films, but localized corrosion (pitting) can occur when the oxide films are broken. HE6 exhibits lower corrosion rates under the immersion test in hydrochloric acid and sulfuric acid for the longer testing duration (72 hours), compared to Stellite 6, also shows a nearly stable corrosion rate with the testing duration extended, indicating better repairing ability of the oxide films.

Biography: Xueyao Wu completed his M.A.Sc. degree in Mechanical Engineering at Carleton University in 2020. Currently, he is a second-year Ph.D. student specializing in metal metallurgy and material characterization. He published a paper on high-entropy alloy in the journal of Metallurgical and Materials Transactions A in 2021 which is a new topic in the research group.