
Mechanism for corrosion resistance of a new trivalent chromium process (TCP) conversion coating on aluminum alloys

Minghao Li, Haoyue Zuo, Yanlong Ma

College of Materials Science and Engineering, Chongqing University of

Technology, Chongqing, 400054, China

myl@cqu.edu.cn

Abstract: The trivalent chromium process (TCP) conversion coating is regarded as the best substitute for the chromate conversion coating (CCC) due to much lower toxicity and comparable corrosion resistance. Recently, a new TCP coating has been developed in house [1]. It has been found that the new TCP coating can provide excellent corrosion protection for 5056 aluminum alloy. However, the corrosion resistance of the TCP coating deteriorates greatly when applied to 2024 and 7075 aluminum alloys. In order to clarify the mechanism behind this phenomenon, the structure and corrosion resistance of the TCP coatings formed under different conditions have been investigated in a comparative manner, which involves TCP coatings on 2024 alloy subjected to different pretreatments and TCP coatings formed on different alloys with the same pretreatment (2024, 5056, 6061, 7050). It is suggested that both the alkaline etching pretreatment and the chemical composition of the alloy greatly affect the structure and corrosion resistance of the TCP coating. Alkaline etching can remove intermetallic particles from the alloy surface and accelerate the dynamics of the TCP coating formation, leading to a more uniform and denser coating structure. Meanwhile, alkaline etching also causes copper enrichment for copper-containing aluminum alloys. The copper enrichment will participate in formation of the coating, resulting in doping of copper species in the coating (mainly in form of Cu_2O), which reduces the corrosion resistance of the coating. The results suggest that the relatively poor corrosion resistance of the TCP coating formed on 2xxx and 7xxx alloy is essentially associated with the copper content in the alloy, and the performance of the coating could hardly be improved by only optimizing the TCP coating structure. Instead, post-treatment must be applied to the TCP coating to improve the corrosion resistance more effectively.

Keywords: Trivalent chromium process (TCP) conversion coating; Aluminum alloy; Surface treatment; Copper enrichment; Corrosion resistance

Reference

[1] Y. Ma, H. Zuo, J. Yan, Y. Jiang, Q. Zhu, Q. Tan, Z. Mao, and J. Lin, "Hydrophobic Chemical Conversion Coating-Forming Liquid and Aluminum Alloy Surface Treatment Method." CN Patent, ZL 2022 1 0804263.2 (2024).