Development of Organic/Inorganic Hybrid Surface Layer With Double Layered Structure for Corrosion Protection of Aluminum With Self-Healing Property

Shibata, Reina (School: National Institute of Technology, Asahikawa College)
Hatakeyama, Noe (School: National Institute of Technology, Asahikawa College)

Aluminum materials are widely used in automobile bodies. However, their corrosion protection is insufficient, necessitating surface treatment techniques to enhance their long-term durability. Once the protective coating is damaged, corrosion begins immediately, exposing the underlying metal to the environment. To address this issue, our laboratory has focused on developing self-healing coatings that can autonomously heal defects without any treatment. We designed a novel self-healing coating system featuring a double-layer structure that exhibits high self-healing efficiency and superior corrosion protection. This system leverages advanced self-healing coating film technology to enhance durability. The coating consists of two different layers: the outer layer is an organic coating containing microcapsules with isophorone diisocyanate (IPDI) as a healing agent, and the inner layer is a porous type of oxide film impregnated with hexamethylene diisocyanate (HDI). When damage occurs, the healing agents are released from both layers and subsequently react with atmospheric moisture to form a self-healing protective structure. In this study, the self-healing capability and corrosion protection of the coatings were evaluated. The results showed that the defect volume was reduced by approximately 45% due to the formation of the self-healing structure. In addition, the corrosion protection of the aluminum substrate was maintained even after the coating was damaged. Future research will focus on improving the corrosion protection of coatings with larger defects.

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