Comparative analysis of the corrosion resistance of *Bos taurus* and *Cocos nucifera*–reinforced 1170 aluminum alloy in chloride-sulfate solution

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Abstract

Aluminum matrix composites have immense industrial significance due to their excellent mechanical, tribological, and heat-resistant properties. Understanding the corrosion resistance of aluminum composites is highly important for the sustained operational lifespan of the composite. AA1170 aluminum alloy with separate particulate reinforcements of *Bos taurus* (BT) and *Cocos nucifera* (CN) (0 to 20% wt concentration) was evaluated for their corrosion resistance properties in 3.5% NaCl and 0.05 M H_2SO_4 solution by potentiodynamic polarization, open circuit potential analysis, potentiostatic analysis, optical and scanning electron microscopy, and X-ray diffractometry. Result analysis showed corrosion rates of monolithic aluminum alloy (0% particulate wt concentration) from both electrolytes (3.5% NaCl and 0.05 M H_2SO_4) are 0.204 and 0.259 mm/year. Corrosion rate of BT-reinforced composites from both solutions decreased with respect to BT particulate concentration to 0.087 and 0.216 mm/year at 20% BT. Whereas corrosion rate of CN-reinforced composites decreased to 0.161 mm/year in 3.5% NaCl and increased to 0.434 mm/year in 0.05 M H_2SO_4 at 20% CN concentration. The most passivated aluminum composites from polarization plots occurred at 5% BT and CN particulate concentrations. Increase in particulate concentration increased the vulnerability of the composite to localized corrosion. Open circuit potential plots show particulate reinforcements increased the thermodynamic instability of the surface properties of aluminum composite and its exposure to active-passive transition behavior. Optical and scanning electron microscopy indicates significant improvements in the corrosion resistance of BT and CN particle–reinforced aluminum compared to the unreinforced alloy. Significant surface deterioration, pitting corrosion, and intergranular corrosion were present. X-ray diffractometry showed the phases identified for BT particle–reinforced composite (Al_2O_3, Cu_S2, Zn_S2, $ZnCO_3$, and CuO_2) significantly enhanced its corrosion resistance compared to the unreinforced and CN particle–reinforced composite.

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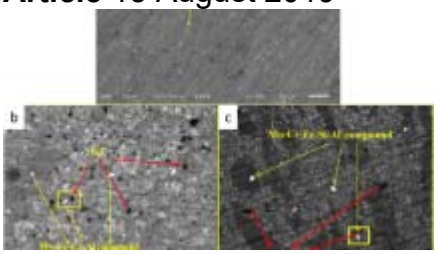

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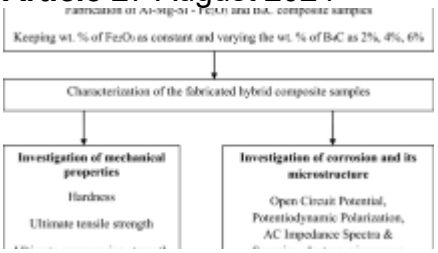

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Contributions

Roland Tolulope Loto is responsible for supervision; conceptualization; and writing—original draft preparation. Ademola Ogunleye, Adeniyi Oladipupo, Sonia Ofordum, and Abisola Ale are responsible for visualization; investigation; validation; methodology; data curation; and writing—original draft preparation

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Ethics declarations

Competing interests

The authors declare no competing interests.

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