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Anticorrosion Effect of Silicon Nitride and Zirconium Diboride Composite on Ni–P–Zn Electroless Deposition on Mild Steel

- [O. Kilanko](#),
- [O. S. I. Fayomi](#) &
- [A. A. Sode](#)

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Abstract

Electroless nickel-based deposition on mild steel surface from a nickel–zinc phosphate bath with $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$, $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$, and $\text{NaH}_2\text{PO}_2 \cdot \text{H}_2\text{O}$ salt in the presence of silicon nitrides and zirconium diboride as additives at a constant time was studied. The structural evolution of electroless deposited mild steel surface was characterized for crystal change formation using a scanning electron microscope (SEM) and elemental quantification done using energy-dispersive spectroscopy (EDS). The electrochemical corrosion analysis of the deposited mild steel with and without composite additives was analyzed using linear polarization resistance and open circuit potential in both H_2SO_4 and NaCl solution. From the results, significant presence and the effect of wt% of additives were noticeable on the electroless mild steel surface. Ni–P–Zn in the presence of 10ZrBr_2 and $10\text{Si}_3\text{N}_4$ actively provide an induced weight gain of 0.0974 g and 0.0973 g, respectively. A correspondent, 0.034 g/m² coating per unit area of zirconium diboride additives, was obtained against 0.030 g/m² for silicon nitrides. The structural evolution shows proper homogeneous crystal formation and stable packed additive concentrated at the lattices with EDS

showing the presence of induced peak. From the corrosion assessment result, electroless deposited mild steel with Ni–P–Zn–10ZrBr₂ and Ni–P–Zn–10Si₃N₄ with optimum particle concentration shows better corrosion resistance performance with a corrosion rate of 0.5048 mm/year, and 5.1347 mm/year, as against the unadditive deposition with 11.393 mm/year in NaCl solution.

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Author information

Affiliations

- 1. Department of Mechanical Engineering, Covenant University, P.M.B 1023, Ota, Nigeria**

O. Kilanko, O. S. I. Fayomi & A. A. Sode

- 2. Department of Chemical, Metallurgical and Materials Engineering, Tshwane University of Technology, P.M.B. X680, Pretoria, South Africa**

O. S. I. Fayomi

Corresponding author

Correspondence to [O. S. I. Fayomi](#).

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