The Combined Influence of Graphene and Copper on the In-Vitro Corrosion Properties and Biocompatibility of a Magnesium Metal Matrix Composite

Song-Jeng Huang

Department of Mechanical Engineering, National Taiwan University of Science and Technology, No. 43, Section 4, Keelung Rd, Da'an District Taipei, 10607, Taiwan, (ROC)

Sivakumar Selvaraju *

Department of Mechanical Engineering, National Taiwan University of Science and Technology, No. 43, Section 4, Keelung Rd, Da'an District Taipei, 10607, Taiwan, (ROC)

Murugan Subramani

Department of Mechanical Engineering, National Taiwan University of Science and Technology, No. 43, Section 4, Keelung Rd, Da'an District Taipei, 10607, Taiwan, (ROC)

Chuan Li *

Department of Biomedical Engineering, National Yang Ming Chiao Tung University, Taipei 11221, Taiwan, (ROC)

Abstract:

This study aims to develop a biodegradable magnesium (Mg) material that combines strength, lightness, and excellent corrosion resistance for biomedical use. AZ31 Mg alloy was reinforced with 0.1 wt% graphene (Gr) and varying amounts of copper (Cu) (0.15 and 0.3 wt%) using mechanical stir casting. The composites' properties were evaluated through microstructural analysis, hardness, compression testing, and corrosion tests. Results showed significant improvements in mechanical strength and corrosion resistance, with compression strength increasing from 364 MPa to 394 MPa and corrosion rate dropping from 9.17 mils/year to 0.135 mils/year. Cytotoxicity tests indicated dose-dependent effects on Wharton's jelly mesenchymal stem cells, with higher Cu levels reducing cell viability. These findings highlight the potential of Mg-based composites for future biomedical implants with tailored properties.

Keywords:

Biomaterials, Magnesium Composites, Microstructural Analysis, Mechanical Properties, Biocompatibility, In-Vitro Immersion and Electrochemical Corrosion.