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Sustainable and Green Coatings for Tribological Applications

Lecture Notes in Civil Engineering • Conference Paper • 2026 •
DOI: 10.1007/978-981-92-1595-9_11

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Abstract

The selection and application of coatings to enhance the performance, durability, and functionality of surfaces in tribological contacts, where friction, wear, and lubrication are critical factors. Therefore, the objective of this work is to develop sustainable hybrid thick coatings using an eco-friendly material and an innovative melting approach known as liquid additive manufacturing (LAM) process. The main hybrid coating materials used are environmentally friendly silicon carbide (eSiC) and graphene oxide (GO) in the LAM process to achieve the desired coating performance properties. The work encompassed the investigation of hardness, friction, and wear of the LAM-processed coated material, employing a microhardness tester and a universal tribometer. A total of nine samples were prepared with eSiC-GO compositions, current and voltage variables. The experimental results demonstrated that the better hardness and wear rates were achieved with the eSiC-GO formulation of 80–20, current of 80 A and voltage of 15 V. The findings conclude that the hardness and wear of the LAM-processed coated surface were significantly improved with eSiC-GO

hybridisation. The findings confirm that this type of thick coating can meet the increasing demands for sustainable and green materials in various industries while providing enhanced performance and durability. By developing coatings with superior tribological properties, this research has the potential to significantly improve the lifespan and performance of components in tribological applications. © The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2026.

Author keywords

Hardness; Sustainable coatings; Titanium alloy; Wear and friction

Indexed keywords

Engineering controlled terms

Coated materials; Coatings; Durability; Friction; Graphene; Green manufacturing; Hybrid materials; Tribology; Wear of materials

Engineering uncontrolled terms

Additive manufacturing process; Graphene oxides; Liquid additives; Performance; Performance durability; Sustainable coating; Thick coatings; Titanium (alloys); Tribological applications; Wear and friction

Engineering main heading

Hardness

Funding details

Details about financial support for research, including funding sources and grant numbers as provided in academic publications.

Funding sponsor	Funding number	Acronym
IOP Specialists Sdn Bhd		
University of Malaya (Malaysia)		
International Islamic University Malaysia See opportunities by IIUM		IIUM

Funding sponsor	Funding number	Acronym
Ministry of Higher Education, Malaysia See opportunities by MOHE ↗	FRGS/1/2021/TK0/UIAM/01/1	MOHE

Funding text

The funding for this research was provided through a grant awarded by the MOHE (FRGS Grant FRGS/1/2021/TK0/UIAM/01/1). The authors would like to extend their gratitude to the International Islamic University Malaysia for providing technical support. The authors are also grateful to the University of Malaya (Malaysia) for supporting this study. Additionally, the authors gratefully acknowledge the travel allowance provided by IOP Specialists Sdn Bhd.

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