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Irfan Ahmed *Editors*

Intelligent Manufacturing and Mechatronics

Selected Articles from iM3F 2023, 7–8 August, Pekan, Malaysia

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Preface

The fourth edition forum of the Innovative Manufacturing, Mechatronics and Materials Forum 2023 (iM3F 2023) organized by Universiti Malaysia Pahang Al-Sultan Abdullah through its Faculty of Manufacturing and Mechatronic Engineering Technology was held on 7 and 8 August 2023. The main field focuses on Manufacturing, Mechatronics as well as Materials.

About 95 submissions were received during iM3F 2023 and were reviewed in a single-blind manner, and 48 papers were advocated by the reviewers to be published in this Springer Proceedings of Materials. The editors would like to express their gratitude to all the authors who submitted their papers. The paper published in this proceeding has been thoroughly reviewed by the appointed technical review committee which consists of various experts in the field of materials and manufacturing engineering.

The conference had brought a new outlook on cutting-edge issues shared through keynote speeches by Assoc. Prof. Ir. Dr. Haji Nik Mohd Zuki Nik Mohamed, Prof. Eng Hwa Yap and Prof. Gian Antonio Susto.

Finally, the editors hope that readers find this volume informative as we thank Springer Proceedings in Materials for undertaking this volume publication. We also would like to thank the conference organization staff and the international program committees' members for their hard work.

Pekan, Pahang, Malaysia
November 2022

Radhiyah Abd. Aziz
Zulhelmi Ismail
A. K. M. Asif Iqbal
Irfan Ahmed

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Abstract

The field of material science and engineering has seen a growing interest in Multifunctional Magnetic Soft Composites (MMSCs) due to their unique magnetic properties, flexibility, and diverse range of functionalities. These composite materials, which possess magnetic responsiveness and adaptability, have been utilized in various fields such as soft robotics and biomedical advancements. Significantly, the incorporation of MMSCs into soft robotic systems has facilitated the ability to navigate complex environments and perform precise object manipulation, thereby surpassing the capabilities exhibited by conventional rigid robots. Moreover, MMSCs have demonstrated potential in various biomedical applications, such as drug delivery systems, medical textiles, and targeted therapies. The progress in fabrication techniques, such as 3D printing, and the integration of novel insulating layers have significantly advanced research on MMSCs, leading to improvements in their characteristics and expanding their range of potential applications. Nevertheless, notwithstanding these notable progressions, there exist certain lacunae in the research, specifically pertaining to the comprehension of time-dependent electric conductivity of MMSCs in high-electric fields and the

investigation of symmetry-breaking actuation mechanisms. By addressing these knowledge deficiencies and effectively utilizing the untapped potential of MMSCs in unexplored areas such as high-voltage systems and diverse biomedical applications, there is a possibility of significantly transforming their influence in multiple sectors. Future research endeavors should give priority to these areas, in order to ensure the ongoing evolution of MMSCs and their crucial role in shaping technological advancements.

References

1. Wu S, Hu W, Ze Q, Sitti M, Zhao R (2020) Multifunctional magnetic soft composites: a review. Multifunctional Mater 3:042003

   Article Google Scholar

2. Han W, Gao W, Wang X (2022) Implementation of printability for magneto-active soft materials based on programmed 3D printing technique. Smart Mater Struct 31:115015

   Article Google Scholar

3. Huang Z, Huang H, He H, Wu Z, Wang X, Wang R (2023) Effect of various metal oxide insulating layers on the magnetic properties of Fe-Si-Cr systems. Coatings 13:804

   Article Google Scholar

4. Zhang Z, Heron JT, Pena-Francesch A (2023) Adaptive magnetoactive soft composites for modular and reconfigurable actuators. Adv Funct Mater 33

   Google Scholar

5. Sinha P, Mukhopadhyay T (2023) On-demand contactless programming of nonlinear elastic moduli in hard magnetic soft beam based broadband active lattice materials. Smart Mater Struct 32:055021

   Article Google Scholar

6. Zhou T, Liu Y, Li J, Wang R, Du J, Ye J, Chen H, Li W, Wu C, Zhang H (2022) Nacre-inspired, efficient, and multifunctional soft magnetic composites by cold sintering design. Adv Eng Mater 24:2101377

   Article Google Scholar

7. Junot G, Wei X, Ortín J, Golestanian R, Wang Y, Tierno P, Meng F (2022) Elastically-mediated collective organisation of magnetic microparticles. Soft Matter 18:5171–5176

Article PubMed Google Scholar

8. García Díez A, Pereira N, Tubio CR, Vilas-Vilela JL, Costa CM, Lanceros-Mendez S (2023) Magnetic polymer actuators with self-sensing resistive bending response based on ternary polymer composites. ACS Appl Electron Mater 5:3426–3435

Article PubMed PubMed Central Google Scholar

9. Stiharu I, Andronenko S, Zinnatullin A, Vagizov F (2023) SICNFE ceramics as soft magnetic material for MEMS magnetic devices: a mössbauer study. Micromachines 14:925

Article PubMed PubMed Central Google Scholar

10. Xie Q, Yu H, Yuan H, Han G, Chen X, Liu Z (2023) Enhanced magnetic properties and thermal conductivity of FESICR soft magnetic composite with Al_2O_3 insulation layer prepared by sol-gel process. Metals 13:813

Article Google Scholar

11. Banerjee H, Leber A, Laperrousaz S, La Polla R, Dong C, Mansour S, Wan X, Sorin F (2023) Soft multimaterial magnetic fibers and textiles. Adv Mater

Google Scholar

12. Hajalilou A, Parvini E, Pereira JP, Lopes PA, Silva AF, De Almeida A, Tavakoli M (2023) Digitally printable magnetic liquid metal composite for recyclable soft?matter electronics. Adv Mater Technol 8

Google Scholar

13. Li G, Shi G, Miao H, Liu D, Li Z, Wang M, Wang L (2023) Effects of the gas-atomization pressure and annealing temperature on the microstructure and performance of FeSiBCuNb nanocrystalline soft magnetic composites. Materials 16:1284

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