Scopus

Documents

Jamadon, N.H.[a] , Rasid, N.I.M.[a] , Ahmad, M.A.[b] , Lutfi, M.[c] , Adzila, S.[d] , Jamal, N.A.[e] , Muhamad, N.[a]

The Effect of Graphene Addition on the Microstructure and Properties of Graphene/Copper Composites for Sustainable Energy Materials

(2023) *IOP Conference Series: Earth and Environmental Science*, 1216 (1), art. no. 012028, . Cited 1 time.

DOI: 10.1088/1755-1315/1216/1/012028

[a] Centre for Materials Engineering and Smart Manufacturing (MERCU), Department of Mechanical and Manufacturing, Faculty of Engineering and Built Environment, Univeristi Kebangsaan Malaysia, Selangor, Bangi, 43600, Malaysia

[b] Faculty of Health Sciences, MAHSA University, Bandar Saujana Putra, , Selangor, Jenjarom, 42610, Malaysia

[c] Faculty of Engineering Built Environment & Information Technology, MAHSA University, Bandar Saujana Putra, Jalan SP2 Selangor, Jenjarom, 42610, Malaysia

[d] Department of Manufacturing Engineering, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja, Johor, Batu Pahat, 86400, Malaysia

[e] Manufacturing and Materials Engineering (MME) Department, Kulliyyah of Engineering, International Islamic University Malaysia, P.O. Box 10, Kuala Lumpur, 50728, Malaysia

Abstract

Graphene is a single thin layer (mono layer) of a hexagon-bound carbon atom and is an allotropic carbon in the form of a hybrid atomic plane, with a molecular bond length of 0.142 nm. Graphene is the thinnest and lightest material with 0.77 mg square meters, which exhibited excellent electricity and heat conductor. However, the perfect uniform microstructure, strength and optimum thermal properties of copper-graphene composites cannot be achieved because the amount of graphene does not reach the optimum level. In order to solve this problem, copper-graphene composites were produced by metal injection molding method (MIM) with various percentage of graphene, specifically 0.5%, 1.0% and 1.5% in the composite, to compare the physical and mechanical properties of these samples. MIM process involves the preparation of feed materials, pre-mixing process, mixing process, mold injection process, binding process and sintering processes. Feeding materials were used are copper and graphene, which have the powder loading of 62% with a mix of binder comprising 73% polyethylene glycol (PEG), 25% polymethyl methacrylate (PMMA), and 2% stearic acid (SA). Densification and tensile test were conducted to determine the mechanical properties. Scanning electron microstructure (SEM) was performed to obtain the microstructure of the composites. From the research, the result revealed that the 0.5% graphene content had the optimum parameter, which the hardness and tensile stress values were at 94.2 HRL and 205.22 MPa. © 2023 Published under licence by IOP Publishing Ltd.

References

- Jamadon, N.H., Tan, A.W., Yusof, F.Z., Ariga, T., Miyashita, Y., Hamdi, M.
(2016) *Utilization of a porous Cu interlayer for the enhancement of Pb-free Sn-3.0ag-0.5Cu solder joint Metals (Basel)*, 6.

- Zahri, N.A.M., Yusof, F., Miyashita, Y., Ariga, T., Haseeb, A.S.Md. A., Jamadon, N.H., Sukiman, N.L.
Brazing of porous copper foam/copper with amorphous Cu-9.7Sn-5.7Ni-7.0P (wt%) filler metal: interfacial microstructure and diffusion behavior
(2020) *Welding in the World*, 64.
209 217

- Stewart, M.
3-Materials of construction Stewart M
(2021) *Surface Production Operations Gulf Professional Publishing Boston*, p. 6192.

- Hatta, F.F., Mohammad Haniff, M.A.S., Mohamed, M.A.
A review on applications of graphene in triboelectric nanogenerators
(2022) *Int J Energy Res*, 46.
544 576

- Tarawneh, M.A., Saraireh, S.A., Chen, R.S., Ahmad, S.H., Al-Tarawni, M.A.M., Yu, L.J., Alsobhi, B.O., Hui, D.

Mechanical reinforcement with enhanced electrical and heat conduction of epoxy resin by polyaniline and graphene nanoplatelets
(2020) *Nanotechnol Rev*, 9, pp. 1550-1561.

- Mohan, V.B., Lau, K., Hui, D., Bhattacharyya, D.
Graphene-based materials and their composites: A review on production, applications and product limitations
(2018) *Compos B Eng*, 142, pp. 200-220.

- Surudzic, R., Jankovic, A., Mitric, M., Matic, I., Juranic, Z.D., Zivkovic, L., Miskovic-Stankovic, V., Hui, D.
The effect of graphene loading on mechanical, thermal and biological properties of poly(vinyl alcohol)/graphene nanocomposites
(2016) *Journal of Industrial and Engineering Chemistry*, 34.
250 257

- Jang, J.-S., Cho, S., Han, H.J., Song, S.-W., Kim, S.-J., Koo, W.-T., Kim, D.-H., Kim, I.
Universal Synthesis of Porous Inorganic Nanosheets via Graphene-Cellulose Templating Route
(2019) *ACS Appl Mater Interfaces*, 11, p. 3410034108.

- Yoon, T., Kim, J.-H., Choi, J.H., Jung, D.Y., Park, I.-J., Choi, S.-Y., Cho, N.S., Kim, T.-S.
Healing Graphene Defects Using Selective Electrochemical Deposition: Toward Flexible and Stretchable Devices
(2016) *ACS Nano*, 10.
1539 1545

- Tang, Y., Yang, X., Wang, R., Li, M.
Enhancement of the mechanical properties of graphene-copper composites with graphene-nickel hybrids
(2014) *Materials Science and Engineering: A*, 599.
247 254

- Chen, F., Ying, J., Wang, Y., Du, S., Liu, Z., Huang, Q.
Effects of graphene content on the microstructure and properties of copper matrix composites
(2016) *Carbon N Y*, 96, p. 836842.

- Güler, Ö., Bagci, N.
A short review on mechanical properties of graphene reinforced metal matrix composites
(2020) *Journal of Materials Research and Technology*, 9.
6808 6833

- Basir, A., Sulong, A.B., Jamadon, N.H., Muhamad, N.
Bi-material micro-part of stainless steel and zirconia by two-component micro-powder injection molding: rheological properties and solvent debinding behavior
(2020) *Metals (Basel)*, 10, p. 595.

- Fu, H., Xu, H., Liu, Y., Yang, Z., Kormakov, S., Wu, D., Sun, J.
Overview of Injection Molding Technology for Processing Polymers and Their Composites ES
(2020) *Materials and Manufacturing*, 8.
3 23

- Basir, A., Sulong, A.B., Jamadon, N.H., Muhamad, N.
Feedstock properties and debinding mechanism of yttria-stabilized zirconia/stainless steel 17-4PH micro-components fabricated via two-component micro-powder injection molding process
Ceram Int, 47.
2021 20476 20485

- Hidalgo-Manrique, P., Lei, X., Xu, R., Zhou, M., Kinloch, I.A., Young, R.J.
  Copper/graphene composites: a review
  (2019) *J Mater Sci*, 54, p. 1223612289.

Correspondence Address
Jamadon N.H.; Centre for Materials Engineering and Smart Manufacturing (MERCU), Selangor, Malaysia; email: nashrahhani@ukm.edu.my

Editors: Noor N.M., Rahim N.L.
Publisher: Institute of Physics

Conference name: 4th International Conference on Green Environmental Engineering and Technology, ICONGEET 2022
Conference date: 17 November 2022 through 18 November 2022
Conference code: 191331

ISSN: 17551307
Language of Original Document: English
Abbreviated Source Title: IOP Conf. Ser. Earth Environ. Sci.
2-s2.0-85169611976
Document Type: Conference Paper
Publication Stage: Final
Source: Scopus