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Recent advances on the enhanced thermal conductivity of graphene nanoplatelets composites: a short review

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Abstract

Graphene nanoplatelets (GNPs) have garnered significant attention in the field of thermal management materials due to their unique morphology and remarkable thermal conductive properties. Their impressive thermal properties make them an interesting choice of nanofillers with which to produce multifunctional composite materials and a host of other applications whilst their structural and thermal properties significantly improve their target materials or composites. Therefore, this present study reviewed recent advances in the use of GNPs as nanofillers to enhance the thermal conductivity of various materials or composites. The improved thermal conductivity

that GNPs impart in composites is also comprehensively compared and discussed. Therefore, this review may reveal hitherto unknown opportunities and pave the way for the production of materials with enhanced thermal applications including electronics, aerospace devices, batteries, and structural reinforcement. © 2022, The Author(s), under exclusive licence to Korean Carbon Society.

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Funding details

References (70)

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All

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1 Kong, W., Kum, H., Bae, S.-H., Shim, J., Kim, H., Kong, L., Meng, Y., (...), Kim, J.

Path towards graphene commercialization from lab to market

(2019) *Nature Nanotechnology*, 14 (10), pp. 927-938. Cited 137 times.
http://www.nature.com/nnano/index.html
doi: 10.1038/s41565-019-0555-2

View at Publisher

2 Novoselov, K.S., Geim, A.K., Morozov, S.V., Jiang, D., Zhang, Y., Dubonos, S.V., Grigorieva, I.V., (...), Firsov, A.A.

Electric field in atomically thin carbon films (Open Access)

(2004) *Science*, 306 (5696), pp. 666-669. Cited 49824 times.
doi: 10.1126/science.1102896

View at Publisher

3 Danial, W.H., Chutia, A., Majid, Z.A., Sahnoun, R., Aziz, M.

Electrochemical synthesis and characterization of stable colloidal suspension of graphene using two-electrode cell system

(2015) *AIP Conference Proceedings*, 1669, art. no. 4919158. Cited 8 times.
http://scitation.aip.org/content/aip/proceeding/aipcp
ISBN: 978-073541316-0
doi: 10.1063/1.4919158

View at Publisher

4 Danial, W.H., Norhisham, N.A., Ahmad Noorden, A.F., Abdul Majid, Z., Matsumura, K., Iqbal, A.

A short review on electrochemical exfoliation of graphene and graphene quantum dots (Open Access)

(2021) *Carbon Letters*, 31 (3), pp. 371-388. Cited 15 times.
https://link.springer.com/journal/42823
doi: 10.1007/s42823-020-00212-3

View at Publisher

5 Tiwari, S.K., Sahoo, S., Wang, N., Huczko, A.

Graphene research and their outputs: Status and prospect (Open Access)

(2020) *Journal of Science: Advanced Materials and Devices*, 5 (1), pp. 10-29. Cited 205 times.
www.journals.elsevier.com/journal-of-science-advanced-materials-and-devices
doi: 10.1016/j.jsamd.2020.01.006

View at Publisher

6 Prabhu, S.A., Kavithayeni, V., Suganthy, R., Geetha, K.

Graphene quantum dots synthesis and energy application: a review

(2021) *Carbon Letters*, 31 (1). Cited 19 times.
https://link.springer.com/journal/42823
doi: 10.1007/s42823-020-00154-w

View at Publisher

7 Osman, S.H., Kamarudin, S.K., Karim, N.A., Basri, S.

Application of graphene in low-temperature fuel cell technology: An overview

(2021) *International Journal of Energy Research*, 45 (13), pp. 18318-18336.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.6969

View at Publisher

8 Ali, S., Ahmad, F., Yusoff, P.S.M.M., Muhamad, N., Oñate, E., Raza, M.R., Malik, K.

A review of graphene reinforced Cu matrix composites for thermal management of smart electronics

(2021) *Composites Part A: Applied Science and Manufacturing*, 144, art. no. 106357. Cited 14 times.
https://www.journals.elsevier.com/composites-part-a-applied-science-and-manufacturing
doi: 10.1016/j.compositesa.2021.106357

View at Publisher

9 Kumar, A., Sharma, K., Dixit, A.R.

A review on the mechanical properties of polymer composites reinforced by carbon nanotubes and graphene

(2021) *Carbon Letters*, 31 (2), pp. 149-165. Cited 55 times.
https://link.springer.com/journal/42823
doi: 10.1007/s42823-020-00161-x

View at Publisher

10 Öztürk, A., Bayrakçeken Yurtcan, A.

Raw and pyrolyzed (with and without melamine) graphene nanoplatelets with different surface areas as PEM fuel cell catalyst supports

(2021) *Carbon Letters*, 31 (6), pp. 1191-1214. Cited 3 times.
https://link.springer.com/journal/42823
doi: 10.1007/s42823-021-00243-4

View at Publisher

11 Gnidakouong, J.R.N., Gao, X., Kafy, A., Kim, J., Kim, J.-H.
Fabrication and electrical properties of regenerated cellulose-loaded exfoliated graphene nanoplatelet composites

(2019) *Carbon Letters*, 29 (2), pp. 115-122. Cited 4 times.
https://link.springer.com/journal/42823
doi: 10.1007/s42823-019-00003-5

View at Publisher

12 Chinkanjanarot, S., Tomasi, J.M., King, J.A., Odegard, G.M.
Thermal conductivity of graphene nanoplatelet/cycloaliphatic epoxy composites: Multiscale modeling

(2018) *Carbon*, 140, pp. 653-663. Cited 31 times.
http://www.journals.elsevier.com/carbon/
doi: 10.1016/j.carbon.2018.09.024

View at Publisher

13 Shaari, N., Kamarudin, S.K., Bahru, R.
Carbon and graphene quantum dots in fuel cell application: An overview

(2021) *International Journal of Energy Research*, 45 (2), pp. 1396-1424. Cited 25 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.5889

View at Publisher

14 Maddah, H.A.
Polypropylene as a promising plastic: a review
(2016) *Am J Polym Sci*, 6, pp. 1-11. Cited 283 times.

15 Vakili, M.H., Ebadi-Dehaghani, H., Haghshenas-Fard, M.
Crystallization and thermal conductivity of $CaCO_3$ nanoparticle filled polypropylene

(2011) *Journal of Macromolecular Science, Part B: Physics*, 50 (8), pp. 1637-1645. Cited 18 times.
doi: 10.1080/00222348.2010.543033

View at Publisher

16 Imran, K.A., Lou, J., Shivakumar, K.N.
Enhancement of electrical and thermal conductivity of polypropylene by graphene nanoplatelets

(2018) *Journal of Applied Polymer Science*, 135 (9), art. no. 45833. Cited 28 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1097-4628
doi: 10.1002/app.45833

View at Publisher

17 King, J.A., Gaxiola, D.L., Johnson, B.A., Keith, J.M.

Thermal conductivity of carbon-filled polypropylene-based resins

(2010) *Journal of Composite Materials*, 44 (7), pp. 839-855. Cited 29 times.
doi: 10.1177/0021998309347578

View at Publisher

18 Medellín-Banda, D.I., Navarro-Rodríguez, D., Fernández-Tavizón, S., Ávila-Orta, C.A., Cadenas-Pliego, G., Comparán-Padilla, V.E.

Enhancement of the thermal conductivity of polypropylene with low loadings of CuAg alloy nanoparticles and graphene nanoplatelets

(2019) *Materials Today Communications*, 21, art. no. 100695. Cited 6 times.
http://www.journals.elsevier.com/materials-today-communications/
doi: 10.1016/j.mtcomm.2019.100695

View at Publisher

19 Li, A., Zhang, C., Zhang, Y.-F.

Thermal conductivity of graphene-polymer composites: Mechanisms, properties, and applications (Open Access)

(2017) *Polymers*, 9 (9), art. no. 437. Cited 210 times.
http://www.mdpi.com/2073-4360/9/9/437/pdf
doi: 10.3390/polym9090437

View at Publisher

20 Wieme, T., Duan, L., Mys, N., Cardon, L., D'hooge, D.R.

Effect of matrix and graphite filler on thermal conductivity of industrially feasible injection molded thermoplastic composites (Open Access)

(2019) *Polymers*, 11 (1), art. no. 87. Cited 23 times.
https://www.mdpi.com/2073-4360/11/1/87/pdf
doi: 10.3390/polym11010087

View at Publisher

21 Song, N., Cao, D., Luo, X., Wang, Q., Ding, P., Shi, L.

Highly thermally conductive polypropylene/graphene composites for thermal management

(2020) *Composites Part A: Applied Science and Manufacturing*, 135, art. no. 105912. Cited 55 times.
https://www.journals.elsevier.com/composites-part-a-applied-science-and-manufacturing
doi: 10.1016/j.compositesa.2020.105912

View at Publisher

22 Zhang, Y., Heo, Y.-J., Son, Y.-R., In, I., An, K.-H., Kim, B.-J., Park, S.-J.

Recent advanced thermal interfacial materials: A review of conducting mechanisms and parameters of carbon materials

(2019) *Carbon*, 142, pp. 445-460. Cited 177 times.
http://www.journals.elsevier.com/carbon/
doi: 10.1016/j.carbon.2018.10.077

View at Publisher

23 Tsekmes, I.A., Kochetov, R., Morshuis, P.H.F., Smit, J.J.

Thermal conductivity of polymeric composites: A review

(2013) *Proceedings of IEEE International Conference on Solid Dielectrics, ICSD*, art. no. 6619698, pp. 678-681. Cited 78 times.
ISBN: 978-147990807-3
doi: 10.1109/ICSD.2013.6619698

View at Publisher

24 Prasher, R.

Thermal interface materials: Historical perspective, status, and future directions

(2006) *Proceedings of the IEEE*, 94 (8), pp. 1571-1586. Cited 704 times.
http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5
doi: 10.1109/JPROC.2006.879796

View at Publisher

25 Wang, Z., Qi, R., Wang, J., Qi, S.

Thermal conductivity improvement of epoxy composite filled with expanded graphite

(2015) *Ceramics International*, 41 (10), pp. 13541-13546. Cited 63 times.
doi: 10.1016/j.ceramint.2015.07.148

View at Publisher

26 Han, Z., Fina, A.

Thermal conductivity of carbon nanotubes and their polymer nanocomposites: A review (Open Access)

(2011) *Progress in Polymer Science (Oxford)*, 36 (7), pp. 914-944. Cited 1811 times.
http://www.sciencedirect.com/science/journal/00796700
doi: 10.1016/j.progpolymsci.2010.11.004

View at Publisher

27 Depaifve, S., Hermans, S., Ruch, D., Laachachi, A.

Combination of micro-computed X-ray tomography and electronic microscopy to understand the influence of graphene nanoplatelets on the thermal conductivity of epoxy composites

(2020) *Thermochimica Acta*, 691, art. no. 178712. Cited 2 times.
https://www.journals.elsevier.com/thermochimica-acta
doi: 10.1016/j.tca.2020.178712

View at Publisher

28 Alawar, A., Bosze, E.J., Nutt, S.R.

A composite core conductor for low sag at high temperatures

(2005) *IEEE Transactions on Power Delivery*, 20 (3), pp. 2193-2199. Cited 109 times.
doi: 10.1109/TPWRD.2005.848736

View at Publisher

29 Hadden, C.M., Klimek-Mcdonald, D.R., Pineda, E.J., King, J.A., Reichanadter, A.M., Miskioglu, I., Gowtham, S., (...), Odegard, G.M.

Mechanical properties of graphene nanoplatelet/carbon fiber/epoxy hybrid composites: Multiscale modeling and experiments (Open Access)

(2015) *Carbon*, 95, pp. 100-112. Cited 164 times.
http://www.journals.elsevier.com/carbon/
doi: 10.1016/j.carbon.2015.08.026

View at Publisher

30 Zha, J.-W., Zhu, T.-X., Wu, Y.-H., Wang, S.-J., Li, R.K.Y., Dang, Z.-M.

Tuning of thermal and dielectric properties for epoxy composites filled with electrospun alumina fibers and graphene nanoplatelets through hybridization

(2015) *Journal of Materials Chemistry C*, 3 (27), pp. 7195-7202. Cited 73 times.
http://pubs.rsc.org/en/journals/journal/tc
doi: 10.1039/c5tc01552a

View at Publisher

31 Chinkanjanarot, S., Radue, M.S., Gowtham, S., Tomasi, J.M., Klimek-McDonald, D.R., King, J.A., Odegard, G.M.

Multiscale thermal modeling of cured cycloaliphatic epoxy/carbon fiber composites (Open Access)

(2018) *Journal of Applied Polymer Science*, 135 (25), art. no. 46371. Cited 21 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1097-4628
doi: 10.1002/app.46371

View at Publisher

32 Barlev, D., Vidu, R., Stroeve, P.

Innovation in concentrated solar power

(2011) *Solar Energy Materials and Solar Cells*, 95 (10), pp. 2703-2725. Cited 436 times.
http://www.sciencedirect.com/science/journal/09270248/100
doi: 10.1016/j.solmat.2011.05.020

View at Publisher

33 Muchuweni, E., Martincigh, B.S., Nyamori, V.O.

Organic solar cells: Current perspectives on graphene-based materials for electrodes, electron acceptors and interfacial layers

(2021) *International Journal of Energy Research*, 45 (5), pp. 6518-6549. Cited 7 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.6301

View at Publisher

34 Ngidi, N.P.D., Ollengo, M.A., Nyamori, V.O.

Heteroatom-doped graphene and its application as a counter electrode in dye-sensitized solar cells

(2019) *International Journal of Energy Research*, 43 (5), pp. 1702-1734. Cited 16 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.4326

View at Publisher

35 Granqvist, C.G.

Transparent conductors as solar energy materials: A panoramic review

(2007) *Solar Energy Materials and Solar Cells*, 91 (17), pp. 1529-1598. Cited 1314 times.
doi: 10.1016/j.solmat.2007.04.031

View at Publisher

36 Yang, J., Qi, G.-Q., Liu, Y., Bao, R.-Y., Liu, Z.-Y., Yang, W., Xie, B.-H., (...), Yang, M.-B.

Hybrid graphene aerogels/phase change material composites: Thermal conductivity, shape-stabilization and light-to-thermal energy storage

(2016) *Carbon*, 100, pp. 693-702. Cited 272 times.
http://www.journals.elsevier.com/carbon/
doi: 10.1016/j.carbon.2016.01.063

View at Publisher

37 Amin, M., Putra, N., Kosasih, E.A., Prawiro, E., Luanto, R.A., Mahlia, T.M.I.

Thermal properties of beeswax/graphene phase change material as energy storage for building applications

(2017) *Applied Thermal Engineering*, 112, pp. 273-280. Cited 212 times.
http://www.journals.elsevier.com/applied-thermal-engineering/
doi: 10.1016/j.applthermaleng.2016.10.085

View at Publisher

38 Sivanathan, A., Dou, Q., Wang, Y., Li, Y., Corker, J., Zhou, Y., Fan, M.

Phase change materials for building construction: An overview of nano-/micro-encapsulation (Open Access)

(2020) *Nanotechnology Reviews*, 9 (1), pp. 896-921. Cited 30 times.
http://www.degruyter.com/view/j/ntrev?rskey=tED3So&result=1
doi: 10.1515/ntrev-2020-0067

View at Publisher

39 Lin, Y., Cong, R., Chen, Y., Fang, G.

Thermal properties and characterization of palmitic acid/nano silicon dioxide/graphene nanoplatelet for thermal energy storage

(2020) *International Journal of Energy Research*, 44 (7), pp. 5621-5633. Cited 12 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.5311

View at Publisher

40 Zhang, N., Jing, Y., Song, Y., Du, Y., Yuan, Y.

Thermal properties and crystallization kinetics of pentaglycerine/graphene nanoplatelets composite phase change material for thermal energy storage

(2020) *International Journal of Energy Research*, 44 (1), pp. 448-459. Cited 10 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.4946

View at Publisher

41 He, L., Li, J., Zhou, C., Zhu, H., Cao, X., Tang, B.

Phase change characteristics of shape-stabilized PEG/SiO_2 composites using calcium chloride-assisted and temperature-assisted sol gel methods

(2014) *Solar Energy*, 103, pp. 448-455. Cited 75 times.
www.elsevier.com/inca/publications/store/3/2/9/index.htt
doi: 10.1016/j.solener.2014.02.042

View at Publisher

42 Tang, Y., Jia, Y., Alva, G., Huang, X., Fang, G.

Synthesis, characterization and properties of palmitic acid/high density polyethylene/graphene nanoplatelets composites as form-stable phase change materials

(2016) *Solar Energy Materials and Solar Cells*, 155, pp. 421-429. Cited 58 times.
http://www.sciencedirect.com/science/journal/09270248/100
doi: 10.1016/j.solmat.2016.06.049

View at Publisher

43 He, L., Wang, H., Zhu, H., Gu, Y., Li, X., Mao, X.

Thermal properties of PEG/graphene nanoplatelets (GNPs) composite phase change materials with enhanced thermal conductivity and photo-thermal performance (Open Access)

(2018) *Applied Sciences (Switzerland)*, 8 (12), art. no. 2613. Cited 12 times.
https://www.mdpi.com/2076-3417/8/12/2613/pdf
doi: 10.3390/app8122613

View at Publisher

44 Hu, K., Kulkarni, D.D., Choi, I., Tsukruk, V.V.

Graphene-polymer nanocomposites for structural and functional applications

(2014) *Progress in Polymer Science*, 39 (11), pp. 1934-1972. Cited 804 times.
http://www.sciencedirect.com/science/journal/00796700
doi: 10.1016/j.progpolymsci.2014.03.001

View at Publisher

45 Liu, Y., Wu, K., Luo, F., Lu, M., Xiao, F., Du, X., Zhang, S., (...), Lu, M.

Significantly enhanced thermal conductivity in polyvinyl alcohol composites enabled by dopamine modified graphene nanoplatelets

(2019) *Composites Part A: Applied Science and Manufacturing*, 117, pp. 134-143. Cited 51 times.
doi: 10.1016/j.compositesa.2018.11.015

View at Publisher

46 Tarannum, F., Muthaiah, R., Annam, R.S., Gu, T., Garg, J.

Effect of alignment on enhancement of thermal conductivity of polyethylene–graphene nanocomposites and comparison with effective medium theory (Open Access)

(2020) *Nanomaterials*, 10 (7), art. no. 1291, pp. 1-12. Cited 10 times.
https://www.mdpi.com/2079-4991/10/7/1291/pdf
doi: 10.3390/nano10071291

View at Publisher

47 Usman, C., Mabrouk, A., Abdala, A.

Enhanced thermal conductivity of polyethylene nanocomposites with graphene, granulated graphene, graphene nanoplatelet, and their hybrids (Open Access)

(2022) *International Journal of Energy Research*, 46 (8), pp. 10218-10227.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.7147

View at Publisher

48 Paszkiewicz, S., Szymczyk, A., Pawlikowska, D., Subocz, J., Zenker, M., Masztak, R.

Electrically and thermally conductive low density polyethylene-based nanocomposites reinforced by MWCNT or hybrid MWCNT/graphene nanoplatelets with improved thermo-oxidative stability (Open Access)

(2018) *Nanomaterials*, 8 (4), art. no. 264. Cited 36 times.
http://www.mdpi.com/2079-4991/8/4/264/pdf
doi: 10.3390/nano8040264

View at Publisher

49 Hashim, H., Adam, N.I., Zaki, N.H.M., Mahmud, Z.S., Said, C.M.S., Yahya, M.Z.A., Ali, A.M.M.

Natural rubber-grafted with 30% poly(methylmethacrylate) characterization for application in lithium polymer battery

(2010) *CSSR 2010 - 2010 International Conference on Science and Social Research*, art. no. 5773825, pp. 485-488. Cited 12 times.
ISBN: 978-142448986-2
doi: 10.1109/CSSR.2010.5773825

View at Publisher

50 Yang, W., Rallini, M., Wang, D.-Y., Gao, D., Dominici, F., Torre, L., Kenny, J.M., (...), Puglia, D.

Role of lignin nanoparticles in UV resistance, thermal and mechanical performance of PMMA nanocomposites prepared by a combined free-radical graft polymerization/masterbatch procedure

(2018) *Composites Part A: Applied Science and Manufacturing*, 107, pp. 61-69. Cited 53 times.
doi: 10.1016/j.compositesa.2017.12.030

View at Publisher

51 Yang, B., Pan, Y., Yu, Y., Wu, J., Xia, R., Wang, S., Wang, Y., (...), Tu, Y.

Filler network structure in graphene nanoplatelet (GNP)-filled polymethyl methacrylate (PMMA) composites: From thermorheology to electrically and thermally conductive properties

(2020) *Polymer Testing*, 89, art. no. 106575. Cited 18 times.
https://www.journals.elsevier.com/polymer-testing
doi: 10.1016/j.polymertesting.2020.106575

View at Publisher

52 Yang, S.-Y., Ma, C.-C.M., Teng, C.-C., Huang, Y.-W., Liao, S.-H., Huang, Y.-L., Tien, H.-W., (...), Chiou, K.-C.

Effect of functionalized carbon nanotubes on the thermal conductivity of epoxy composites

(2010) *Carbon*, 48 (3), pp. 592-603. Cited 317 times.
doi: 10.1016/j.carbon.2009.08.047

View at Publisher

53 Pan, Y., Yang, B., Jia, N., Yu, Y., Xu, X., Wang, Y., Wu, B., (...), Shi, Y.

Enhanced thermally conductive and thermomechanical properties of polymethyl methacrylate (PMMA)/graphene nanoplatelets (GNPs) nanocomposites for radiator of electronic components (Open Access)

(2021) *Polymer Testing*, 101, art. no. 107237. Cited 7 times.
https://www.journals.elsevier.com/polymer-testing
doi: 10.1016/j.polymertesting.2021.107237

View at Publisher

54 Mirjalili, V., Ramachandramoorthy, R., Hubert, P.

Enhancement of fracture toughness of carbon fiber laminated composites using multi wall carbon nanotubes

(2014) *Carbon*, 79 (1), pp. 413-423. Cited 28 times.
http://www.journals.elsevier.com/carbon/
doi: 10.1016/j.carbon.2014.07.084

View at Publisher

☐ 55 Kandare, E., Khatibi, A.A., Yoo, S., Wang, R., Ma, J., Olivier, P., Gleizes, N., (...), Wang, C.H.

Improving the through-thickness thermal and electrical conductivity of carbon fibre/epoxy laminates by exploiting synergy between graphene and silver nano-inclusions

(2015) *Composites Part A: Applied Science and Manufacturing*, 69, pp. 72-82. Cited 153 times.
doi: 10.1016/j.compositesa.2014.10.024

View at Publisher

☐ 56 Wang, F., Cai, X.

Improvement of mechanical properties and thermal conductivity of carbon fiber laminated composites through depositing graphene nanoplatelets on fibers

(2019) *Journal of Materials Science*, 54 (5), pp. 3847-3862. Cited 35 times.
doi: 10.1007/s10853-018-3097-3

View at Publisher

☐ 57 Martins, M., Gomes, R., Pina, L., Pereira, C., Reichmann, O., Teti, D., Correia, N., (...), Rocha, N.

Highly conductive carbon fiber-reinforced polymer composite electronic box: Out-of-autoclave manufacturing for space applications (Open Access)

(2018) *Fibers*, 6 (4), art. no. 92. Cited 14 times.
https://res.mdpi.com/fibers/fibers-06-00092/article_deploy/fibers-06-00092-v2.pdf?filename=&attachment=1
doi: 10.3390/fib6040092

View at Publisher

☐ 58 Wang, S., Han, S., Xin, G., Lin, J., Wei, R., Lian, J., Sun, K., (...), Yu, Q.

High-quality graphene directly grown on Cu nanoparticles for Cu-graphene nanocomposites

(2018) *Materials and Design*, 139, pp. 181-187. Cited 48 times.
doi: 10.1016/j.matdes.2017.11.010

View at Publisher

☐ 59 Fang, B., Li, J., Zhao, N., Shi, C., Ma, L., He, C., He, F., (...), Liu, E.

Boron doping effect on the interface interaction and mechanical properties of graphene reinforced copper matrix composite

(2017) *Applied Surface Science*, 425, pp. 811-822. Cited 17 times.
http://www.journals.elsevier.com/applied-surface-science/
doi: 10.1016/j.apsusc.2017.07.084

View at Publisher

☐ 60 Chen, X., Tao, J., Yi, J., Liu, Y., Li, C., Bao, R.

Strengthening behavior of carbon nanotube-graphene hybrids in copper matrix composites

(2018) *Materials Science and Engineering A*, 718, pp. 427-436. Cited 54 times.
http://www.elsevier.com
doi: 10.1016/j.msea.2018.02.006

View at Publisher

61 Guo, S., Zhang, X., Shi, C., Liu, E., He, C., He, F., Zhao, N.

In situ synthesis of high content graphene nanoplatelets reinforced Cu matrix composites with enhanced thermal conductivity and tensile strength

(2020) *Powder Technology*, 362, pp. 126-134. Cited 23 times.
www.elsevier.com/locate/powtec
doi: 10.1016/j.powtec.2019.11.121

View at Publisher

62 Chu, K., Wang, X.-H., Wang, F., Li, Y.-B., Huang, D.-J., Liu, H., Ma, W.-L., (...), Zhang, H.

Largely enhanced thermal conductivity of graphene/copper composites with highly aligned graphene network

(2018) *Carbon*, 127, pp. 102-112. Cited 177 times.
http://www.journals.elsevier.com/carbon/
doi: 10.1016/j.carbon.2017.10.099

View at Publisher

63 Yan, Z., Nika, D.L., Balandin, A.A.

Thermal properties of graphene and few-layer graphene: Applications in electronics

(2015) *IET Circuits, Devices and Systems*, 9 (1), pp. 4-12. Cited 74 times.
http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4123966
doi: 10.1049/iet-cds.2014.0093

View at Publisher

64 Bahru, R., Zamri, M.F.M.A., Shamsuddin, A.H., Shaari, N., Mohamed, M.A.

A review of thermal interface material fabrication method toward enhancing heat dissipation

(2021) *International Journal of Energy Research*, 45 (3), pp. 3548-3568. Cited 12 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-114X
doi: 10.1002/er.6078

View at Publisher

65 Lv, J., Cai, X., Ye, Q., Zhang, H., Ruan, Z., Cai, J.

Significant improvement in the interface thermal conductivity of graphene-nanoplatelets/silicone composite

(2018) *Materials Research Express*, 5 (5), art. no. 055606. Cited 5 times.
http://iopscience.iop.org/article/10.1088/2053-1591/aac46e/pdf
doi: 10.1088/2053-1591/aac46e

View at Publisher

66 Chen, J.K., Huang, I.S.

Thermal properties of aluminum-graphite composites by powder metallurgy

(2013) *Composites Part B: Engineering*, 44 (1), pp. 698-703. Cited 171 times.
doi: 10.1016/j.compositesb.2012.01.083

View at Publisher

67 Zhou, W., Bang, S., Kurita, H., Miyazaki, T., Fan, Y., Kawasaki, A.

Interface and interfacial reactions in multi-walled carbon nanotube-reinforced aluminum matrix composites

(2016) *Carbon*, 96, pp. 919-928. Cited 158 times.
http://www.journals.elsevier.com/carbon/
doi: 10.1016/j.carbon.2015.10.016

View at Publisher

68 Wang, J., Li, Z., Fan, G., Pan, H., Chen, Z., Zhang, D.

Reinforcement with graphene nanosheets in aluminum matrix composites (Open Access)

(2012) *Scripta Materialia*, 66 (8), pp. 594-597. Cited 688 times.
doi: 10.1016/j.scriptamat.2012.01.012

View at Publisher

69 Wang, C., Su, Y., Ouyang, Q., Zhang, D.

Enhanced through-plane thermal conductivity and mechanical properties of vertically aligned graphene nanoplatelet@graphite flakes reinforced aluminum composites

(2020) *Diamond and Related Materials*, 108, art. no. 107929. Cited 8 times.
https://www.journals.elsevier.com/diamond-and-related-materials
doi: 10.1016/j.diamond.2020.107929

View at Publisher

70 Wu, F., Chen, A., Pan, H., Li, D., Zhang, L., Fang, H., Peng, X., (...), Bekyarova, E.

Synergistic enhancement of thermal conductivity by addition of graphene nanoplatelets to three-dimensional boron nitride scaffolds for polyamide 6 composites

(2021) *Polymer Engineering and Science*, 61 (5), pp. 1415-1426. Cited 3 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1548-2634
doi: 10.1002/pen.25658

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