**On the electronic properties of graphene-based nanocomposites**

**Mainak Saha**

1Department of Metallurgical and Materials Engineering, National Institute of Technology Durgapur-713209, India

\*E-mail of Corresponding author: mainaksaha1995@gmail.com

**Author’s viewpoints:**

In the context of electronic conductivity, Graphene is best electrical conductor identified till date [1]. This property makes it an ideal candidate for fabricating nanocomposites for flexible energy devices [1]. However, at present, the main challenge is to fabricate graphene-based nanocomposites by the assembly of graphene nanosheets based on traditional synthesis techniques [2]. To address the aforementioned challenge, recently, there has been a huge volume of research aimed towards addressing structure-property correlation in graphene-based nanocomposites, synthesized by a number of different methods [2]–[4]. The electronic properties of these composites, are mainly dependent on two process parameters (viz. (i) the nature of reinforcement and (ii) method of synthesis) and a structural parameter [5]–[9]**.** Among these, the two process parameters highly influence the structural parameter and play a significant role in the electronic transport mechanisms in this type of materials [10]–[14]. In addition, the electron-point defect, electron-2D interface interaction and the electron-porosity interaction (especially in the context of porous nanomaterials) largely influence the electronic properties.

**References**:

[1] S. Wan, J. Peng, L. Jiang, and Q. Cheng, “Bioinspired Graphene-Based Nanocomposites and Their Application in Flexible Energy Devices,” *Advanced Materials*, vol. 28, no. 36. Wiley-VCH Verlag, pp. 7862–7898, Sep. 28, 2016, doi: 10.1002/adma.201601934.

[2] M. Saha, “Carbon-Based Nanocomposites: Processing, Electronic Properties and Applications,” Springer, Singapore, 2021, pp. 97–122.

[3] M. Baibarac, P. Gomez-Romero, M. Lira-Cantu, N. Casañ-Pastor, N. Mestres, and S. Lefrant, “Electrosynthesis of the poly(N-vinyl carbazole)/carbon nanotubes composite for applications in the supercapacitors field,” *European Polymer Journal*, vol. 42, no. 10, pp. 2302–2312, Oct. 2006, doi: 10.1016/j.eurpolymj.2006.05.019.

[4] P. H. C. Camargo, K. G. Satyanarayana, and F. Wypych, “Nanocomposites: Synthesis, structure, properties and new application opportunities,” *Materials Research*, vol. 12, no. 1. Universidade Federal de Sao Carlos, pp. 1–39, 2009, doi: 10.1590/S1516-14392009000100002.

[5] R. Sanjinés, M. D. Abad, C. Vâju, R. Smajda, M. Mioni, and A. Magrez, “Surface & Coatings Technology Electrical properties and applications of carbon based nanocomposite materials : An overview,” vol. 206, pp. 727–733, 2011, doi: 10.1016/j.surfcoat.2011.01.025.

[6] X. Wu *et al.*, “Advanced Carbon-Based Anodes for Potassium-Ion Batteries,” *Advanced Energy Materials*, vol. 9, no. 21. Wiley-VCH Verlag, p. 1900343, Jun. 05, 2019, doi: 10.1002/aenm.201900343.

[7] X. M. Liu *et al.*, “Carbon nanotube (CNT)-based composites as electrode material for rechargeable Li-ion batteries: A review,” *Composites Science and Technology*, vol. 72, no. 2. Elsevier, pp. 121–144, Jan. 18, 2012, doi: 10.1016/j.compscitech.2011.11.019.

[8] C. S. Yang, Y. S. Jang, and H. K. Jeong, “Bamboo-based activated carbon for supercapacitor applications,” *Current Applied Physics*, vol. 14, no. 12, pp. 1616–1620, 2014, doi: 10.1016/j.cap.2014.09.021.

[9] Z. Sun *et al.*, “Conductive porous vanadium nitride/graphene composite as chemical anchor of polysulfides for lithium-sulfur batteries,” *Nature Communications*, vol. 8, 2017, doi: 10.1038/ncomms14627.

[10] M. Ates, A. A. Eker, and B. Eker, “Carbon nanotube-based nanocomposites and their applications,” *Journal of Adhesion Science and Technology*, vol. 31, no. 18. Taylor and Francis Ltd., pp. 1977–1997, Sep. 17, 2017, doi: 10.1080/01694243.2017.1295625.

[11] Y. Lu *et al.*, “Room temperature methane detection using palladium loaded single-walled carbon nanotube sensors,” *Chemical Physics Letters*, vol. 391, no. 4–6, pp. 344–348, Jun. 2004, doi: 10.1016/j.cplett.2004.05.029.

[12] A. Star, V. Joshi, S. Skarupo, D. Thomas, and J. C. P. Gabriel, “Gas sensor array based on metal-decorated carbon nanotubes,” *Journal of Physical Chemistry B*, vol. 110, no. 42, pp. 21014–21020, Oct. 2006, doi: 10.1021/jp064371z.

[13] I. v. Lebedeva, A. A. Knizhnik, A. A. Bagatur’yants, and B. v. Potapkin, “Kinetics of 2D-3D transformations of carbon nanostructures,” *Physica E: Low-Dimensional Systems and Nanostructures*, vol. 40, no. 7, pp. 2589–2595, May 2008, doi: 10.1016/j.physe.2007.09.155.

[14] V. V. N. Obreja, “On the performance of supercapacitors with electrodes based on carbon nanotubes and carbon activated material-A review,” *Physica E: Low-Dimensional Systems and Nanostructures*, vol. 40, no. 7, pp. 2596–2605, May 2008, doi: 10.1016/j.physe.2007.09.044.