Graphene flexible electronic device for lighting LEDs

J. Martinez[1], A. Ladron de Guevara[1], D. J. Choi[2], A. Bosca[1], J. Pedros[1], F. Calle[1]

1 ISOM - UPM, E.T.S.I.Telecomunicacion, Madrid, Spain
2 Division of Materials Science and Engineering, Hanyang University, Seoul, Korea
javier.martinez@upm.es

Abstract

Graphene, has attracted increasing attention in recent years [1] due to its excellent mechanical, optical and electrical properties. Its high theoretical surface area (2630 m^2 g^{-1}) and high electrical conductivity make it an attractive material for many industrial applications [2]. Also is a flexible transparent material that can be used for solar cells, light emitting diodes (LEDs, OLEDs), touchscreens and LCD displays [3].And in the near future, its flexibility will let to create foldable and wearable devices[4].

A layer of graphene can be prepared by several techniques: by mechanical exfoliation from graphite, by precipitation on a silicon carbide surface, by reduction of exfoliated graphene oxide, and by chemical vapor deposition growth on Cu or Ni. The most used one is the CVD, and the synthesized graphene is commonly grown on a flat metal foil or thin film. This method provides high quality graphene, and can also fabricate 3D graphene structures using metallic foams.

The large area and porosity of this 3D graphene structures, makes them an ideal material for flexible electronics. In order to create this structures, we used a 1 x1 cm^2 Ni foam as the catalytic template to form graphene layers by plasma-enhanced CVD (PECVD). After this step, the Ni was removed by a wet etching in HCl acid, obtaining a soft graphene foam with the same porous size. Figure 1 shows an image of the foam by scanning electron microscopy (SEM). This graphene foam has a very high conductivity and can used for flexible electronics.

The graphene foams were coated partially with PMMA for mechanical stability and sealed inside a plastic container with an electrolyte and two electrical contacts. This flexible device can store energy when is polarized by a positive bias and can light up several commercial LEDs as it is shown in the Figure 2.

***Acknowledgements*.** This work has been partially supported by Ministerio de Economía y Competitividad (Project No. TEC 2010-19511) and technical advice from Repsol.

References

[1] B. Luo, S. Liu, L. Zhi, Small **8** (2012) 630.
[2] M. D. Stoller, S. Park, Y. Zhu, J. An, R. S. Ruoff, Nano Letter, **8** (2008) 3498.
[3] X. Cao, Y. Shi, W. Shi, G. Lu, X. Huang, Q. Yan, Q. Zhang, and H. Zhang, Small **7** (2011) 3163.
[4] M. F. El-Kady, V. Strong, S. Dubin, R. B. Kaner, Science **335** (2012) 1326

Figures

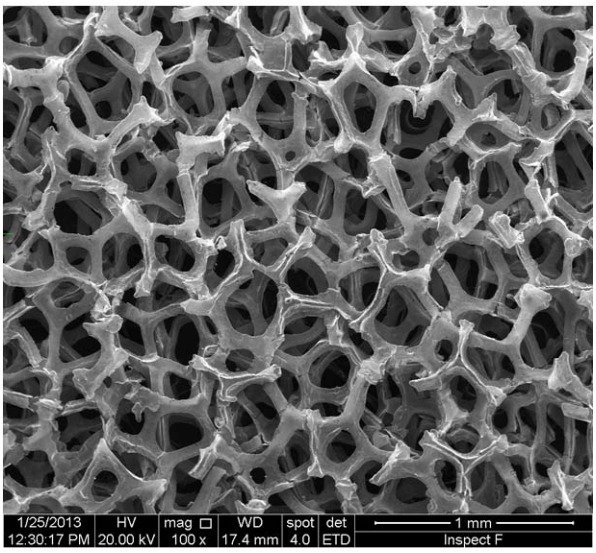

Figure 1. SEM picture of the graphene 3D foam

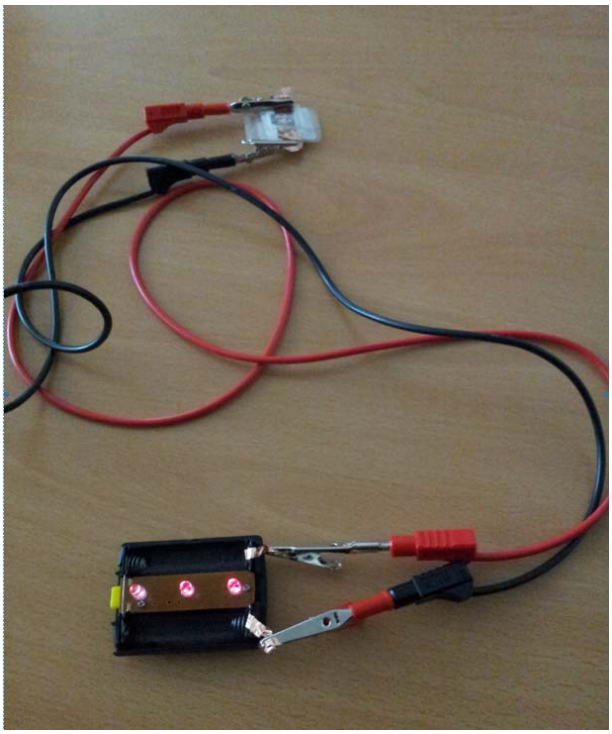

Figure 2. Picture of the flexible device lighting up 3 LEDs