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Graphene based inkjet-printable electrodes for dye sensitized solar cells

David Dodoo-Arhin[1], Richard Howe[2], Guohua Hu[2], Tawfique Hasan[2]
[1]*Department Of Materials Science And Engineering, University Of Ghana, Accra, Ghana,* [2]*Cambridge Graphene Centre, Cambridge University, Cambridge, United Kingdom*
E-mail: DDARHIN@YAHOO.COM

We present a stable inkjet printable graphene ink, formulated in isopropyl alcohol via liquid phase exfoliation of chemically pristine graphite with a polymer stabilizer. The rheology and low deposition temperature of the ink allow uniform printing. We use the graphene ink to fabricate counter electrodes (CE) for natural and ruthenium-based dye-sensitized solar cells (DSSCs). The repeatability of the printing process for the CEs is demonstrated through an array of inkjet-printed graphene electrodes, with ~5% standard deviation in the sheet resistance. As photosensitizers, we investigate natural tropical dye extracts from Pennisetum glaucum, Hibiscus sabdariffa and Caesalpinia pulcherrima. Among the three natural dyes, we find extracts from C. pulcherrima exhibit the best performance, with ~0.9% conversion efficiency using a printed graphene CE and a comparable ~1.1% efficiency using a platinum (Pt) CE. When used with N719 dye, the inkjet-printed graphene CE shows a ~3.0% conversion efficiency, compared to ~4.4% obtained using Pt CEs. Our results show that inkjet printable graphene inks, without any chemical functionalization, offers a flexible and scalable fabrication route, with a material cost of only ~2.7% of the equivalent solution processed Pt-based electrodes.

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