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Green Graphene Inks Printed by Aerosol-Jet for Sensing Applications

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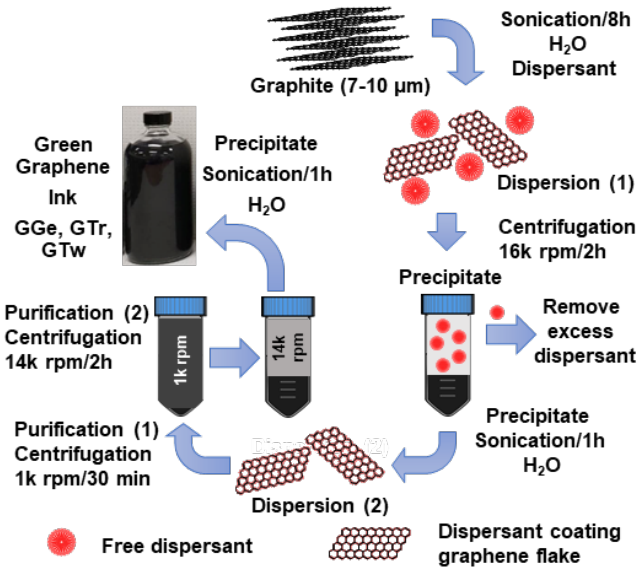
Abstract

This study presents green graphene inks produced through liquid-phase exfoliation of graphene flakes in water using optimized concentrations of dispersants. The study compares the effectiveness of three different dispersants (gelatin, triton X-100, and tween-20) in creating stable and conductive inks that can be printed onto polyethylene terephthalate (PET) substrates using an aerosol-jet printer. The study analyzes and discusses the chemical, printability, mechanical, and electrochemical properties of the developed inks based on the dispersant used. Our findings indicate that triton X-100 is the most effective dispersant for formulating graphene ink (GTr), which demonstrated superior electrical conductivity (4.5 S.cm-1), a high nanofiller concentration of graphene flakes (12.2%) with a size smaller than 200 nm (< 200 nm), a low dispersant-to-graphene ratio (5%), good quality as measured by Raman spectroscopy (ID/IG ≈ 0.27), and good wettability (θ ≈ 42°) over PET. The GTr's ecological benefits, combined with its excellent printability and good conductivity, make it an ideal candidate for manufacturing chemiresistive sensors that can be used for Internet of Things (IoT) healthcare and environmental applications.



Recent Publications

1. Al Shaboul, A*; Ketabi, M*; Izquierdo, R. (2021). Conductive Green Graphene inks for Printed Electronics. 2021 IEEE 16th Nanotechnology Materials and Devices Conference (NMDC). 2021 Vancouver, Canada (1-4).
2. Al Shboul, A. M.; Ketabi, M.; Mechael, S. S.; Nyayachavadi, A.; Rondeau-Gagné, S.; Izquierdo, R. Hydrogen Sulfide Gas Detection in Ppb Levels at Room Temperature with a Printed, Flexible, Disposable In_2O_3 NPs-Based Sensor for IoT Food Packaging Applications. Adv. Mater. Technol. 2023, 8 (2), 2201086.
3. Al Shboul, A.; Shih, A.; Izquierdo, R. A Flexible Indium Oxide Sensor with Anti-Humidity Property for Room Temperature Detection of Hydrogen Sulfide. IEEE Sens. J. 2021, 21 (8), 9667–9674.

Biography

R. Izquierdo: After an eight-year career in the industry as a researcher then R&D director at Technologies Novimage-OLA Display he joined as a professor the Microelectronics engineering program at the Université du Québec à Montréal (UQAM) in 2005. At UQAM he contributed to the emergence of two institutional research centers one in the field on nanomaterials (NanoQAM) were he served as adjunct director from 2007 to 2010 and a second in the field of microsystems (CoFaMic) which he directed from 2010 to 2016. Since 2016 is a Full professor in the electrical engineering department at the École de Technologie Superieure from the Université du Québec (ETS). At ETS he is also the director of the LACIME research center. He is a highly recognized expert in sensors and printed electronics with more than 2300 citations and 30 invited talks.

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