Smart "Sticky Note" for strain and temperature sensing using few-layer graphene from exfoliation in red spinach solution

Wan Farhana W Idris[a], Nurul Farhana Abu Kasim[a], Abu Hannifa Abdullah[b], Zulsyawan Ahmad Khusairi[c], Kamal Yusoh[b], ZulhelmiI smail[a]

[a]Innovative Materials Focused Group (INNOMAT), Faculty of Manufacturing Engineering, Universiti Malaysia Pahang, Pekan, Pahang, Malaysia
[b]Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Gambang, Pahang, Malaysia
[c]School of Foundation and Interdisciplinary Studies, DRB-HICOM University of Automotive Malaysia, Pekan, Pahang, Malaysia

Abstract

The synthesis of few-layer graphene from graphite typically uses N, N methyl pyrrolidone (NMP) or dimethylformamide (DMF) due to the strong affinity of both solvents for graphite. However, NMP and DMF are known as carcinogens and a long-time exposure to these substances may subject users to potential risk of major health issue later. Therefore, a replacement with dispersing solvent that is not only harmless but also able to exfoliate graphite at an excellent concentration yield must be outlined for a sustainable mass-production of graphene. In this work, we have successfully exfoliated graphite to few-layer graphene with a recorded yield concentration of up to 0.75°mg/ml (2.5°h) just by using extracted red spinach/water mixture as an exfoliating medium. The prepared graphene was found to possess less structural defect (I_D/I_G: 0.5) and high C/O ratio (6.8) and can be used further as an electrical conductive ink for smart "Sticky Note" sensor. The fabricated device was able to detect strain and temperature with gauge factor and temperature coefficient resistance of 23.5 and -32.14×10^{-4}°Ω/°;C, respectively. We believe that this study would be useful for the preparation of environmental-friendly graphene that is not only strain and thermally sensitive but also producible at low -cost.