Electrical Power Generation From Contrasting Interfacial Activities of Boron and Nitrogen Doped Graphene Extracted From Plastic Waste

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Management of waste plastic and the uneven distribution of electrical energy supply around the world are among the greatest challenges before the scientific community. The present work proposes a combined solution by demonstrating the formation of electrical energy from plastic waste using a device manufactured using chemically altered waste plastic. Collected waste plastic was cleaned, dried, shredded, and mixed with Boric Acid Powder in three dopant concentrations (3:1, 3:2, 3:3). It was made to undergo a novel two step pyrolysis process – a slow temperature increment to a transition temperature followed by a fast temperature increment to a target temperature in inert atmosphere – resulting in a black charred residue hypothesised to be Boron doped Graphene. The process was repeated replacing Boric Acid Powder with Urea, which also resulted in a black charred powder hypothesised to be Nitrogen doped Graphene. Dispersions of the Boron and Nitrogen doped Graphene samples were separately formed in NMP using a Lambda Probe Sonicator and coated onto Whatman filter membranes (1.5 cm x 2 cm) by drop casting. A device was then fabricated by attaching copper wires (electrodes) to the doped sides of the Whatman filters and the filters were brought in close proximity, facing each other, with a contraption. After dipping the device in a few millilitres of water and connecting it to a source metre, the contraption reported voltages up to 120 mV and currents up to 70 μA from 6 grams of plastic waste. The power output was discovered to be dependent on the coating-area, dopant concentration, annealing temperature, and ionic conductivity. Furthermore, PXRD, FTIR, Raman Spectroscopy, and TEM characterisations confirmed successful formation of Boron and Nitrogen doped Graphene.

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