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

Das, Ahitagni (School: Delhi Public School Siliguri)

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.

Awards Won:

King Abdulaziz &amp

his Companions Foundation for Giftedness and Creativity: Full Scholarship from King Fahd University of Petroleum and Minerals(KFUPM) (and a $400 cash prize)