Synthesis of Graphene From Noxious Solid Waste Petroleum Coke: Evaluation for Supercapacitor Application

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Petroleum coke, a carbon-based solid residue produced by oil refinery industries, poses substantial environmental and health risks with its emission of large amounts of toxic sulfur and carbon dioxides. Conversely, emerging technologies demand materials with lightweight, superior electric conductivity, and remarkable durability. While graphene holds promise for these features in several applications, some challenges persist in the sustainable, cost-effective, and scalable production of graphene. This research addresses these challenges by developing a cost-effective production method using ultrasonication to convert negative-value petroleum coke into valuable graphene. The project aims to study the effect of the concentration and type of alcoholic solvents on the microstructure and properties of the produced graphene.. The received petroleum coke was ball-milled to become fine powder, then converted into graphene through ultrasonic exfoliation and using various alcoholic solvents as a medium, most notably ethanol:water in a 1:1 ratio. Microstructural analysis using XRD, SEM, EDS, Raman, and FT-IR confirmed successful graphene synthesis with 2D morphology and graphitic carbon presence. The samples with 7:3 and 1:1 concentrations of ethanol:water exhibited the highest 2D peaks. These samples were used to fabricate, a two-electrode device, and they exhibited good retention capacity over 3000 cycles. This method is proved to be simple and cost-effective, with an approximate production cost of $22,028 per ton and a 65% yield (1g of petcoke produced 0.65g of graphene). This research addresses the economic dilemmas facing graphene and tackles environmental issues associated with petroleum waste, paving the way for a greener Earth and method for mass-producing graphene.

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