FUNCTIONALIZED GRAPHENE QUANTUM DOTS FROM RESIDUAL OIL FRACTIONS AS ADDITIVES FOR ELECTRIC VEHICLE CONDUCTIVE LUBRICANTS

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ABSTRACT

Electric currents flowing through Electric Vehicle (EV) components can induce aggressive wear damage via Electric Discharge Machining (EDM) [1]. One effective mitigation strategy involves developing lubricants capable of dissipating current in tribological contacts, such as bearings and gears, to prevent charge buildup [2]. However, the literature lacks a comprehensive experimental study on additives that simultaneously enhance lubricity and confer electrical conductivity to lubricants.

In this study, we synthesized a novel lubricant additive comprising Graphene Quantum Dots (GQDs), derived from the mild oxidation of residual oil fractions [3]. These GQDs were functionalized via esterification with Hexan-1-ol to enhance dispersibility in a non-polar base oil. Characterization techniques including Transmission Electron Microscopy (TEM), High-Resolution TEM (HRTEM), X-ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), Raman Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), and Nuclear Magnetic Resonance (NMR) were employed to assess the additive's properties. These analyses confirmed successful synthesis and functionalization.

Addition of 1% w/w esterified GQDs to AramcoPrima (AP230) base oil demonstrated excellent dispersion stability, maintaining consistent color and homogeneity over months without sedimentation. Furthermore, this addition resulted in a significant reduction in the coefficient of friction (by approximately 40%) and wear scar size (by approximately 20%), while achieving the desired electrical conductivity levels in the oil.

This research addresses a gap in the literature by providing a comprehensive experimental investigation into the synergistic effects of GQDs as lubricant additives, offering promising implications for enhancing both tribological performance and electrical conductivity in lubrication systems.

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