Novel Graphene Nanoplatelet and Ketjenblack Embedded Pigmentless Acrylic Emulsions for Next Generation Flexible Electronics

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Electronic designs are currently transitioning towards innovative next-generation form factors such as flexible and foldable architectures. However, these designs are extremely expensive and small due to the utilization of costly materials and highly complex fabrication methods that are only economically viable for small scale specialized electronics. A paintable high performance carbon nanomaterial would enable electronics that are flexible, low cost, large area and applicable on any surface. Graphene nanoplatelets (GnPs), derived from graphite, are a material with tremendous potential in electronic applications for its high strength, high electrical conductivity and low-cost. In this study, large 25μm planar GnPs are dispersed in a novel medium, pigmentless acrylic emulsion, and doped with highly conductive spherical Ketjenblack to increase the electrical properties of GnPs via synergistic carbon nanostructures. The film morphology, characterized by Scanning Electron Microscopy, was continuous and uniform with interspersed networks of dense carbon nanostructures. Experimentation of variable loadings and ratios, novel research, found optimum material parameters for low resistance. The highest performing formulation demonstrated a sheet resistance of 14.4 Ω/sq/mil, several magnitudes lower than industry standard carbons with high flexibility of 97% performance retention after 100 bend cycles. The optimum formulation of 28% GnP doped with 2% Ketjenblack exhibited 33% higher electrical conductivity than traditional GnP only composite materials with zero added cost. This newly fabricated composite nanomaterial offers dramatic improvements in conductivity, flexibility and cost which is promising for the commercialization of graphene-based flexible electronics.

Awards Won:

Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Intel ISEF Category