

ISGD7

*7th International Symposium on Graphene Device
26 - 29 July, 2021 / WASHINGTON, D.C*

Graphene functionalization - how combining the right functionalization approaches can lead to IR transparent conductors and ultra-sensitive sulfur sensors

Evgeniya Lock

1Naval Research Laboratory,
Washington DC 20375

Graphene – a wonder material – it is composed entirely of surface atoms, with exceptional physicochemical properties including high specific surface area, high carrier mobilities, and extremely low noise characteristics, thus making graphene extremely sensitive. However, graphene is not selective and thus multiple functionalization approaches have been developed to address this problem including free radical addition reactions, cycloaddition, the introduction of single atoms and plasma-based approaches. The defects into graphene's structure vary depending on the method, and are not well controlled and/or stable over time.

In this talk, I will summarize our work on graphene functionalization and its effects on graphene's chemical, structural and electrical properties. Indeed, we demonstrate that graphene functionalization without deterioration of electrical properties is possible. This is confirmed by detection of the Quantum Hall Effect and Shubnikov-de Haas oscillations, both associated with high quality exfoliated graphene flakes. Furthermore, we demonstrate that the created functional groups can be used as linker molecules for attachment of nanoparticles and other moieties to the graphene films. Then, I will show two applications of our functionalization techniques used for the development of (1) IR transparent inorganic and organic conductors, and (2) ultrasensitive graphene sensors to detect sulfur concentration in logistic fuel. Finally, I will discuss the uniqueness of these functionalized graphene sensors given that there is no other known fieldable technology that can detect sulfur species or offers the flexibility for further heteroatomic speciation.

This work is partially supported by the Office of Naval Research through Naval Research Laboratory Base Program.

Distribution A: Approved for public release, distribution unlimited.