Characterization of Light-Matter Interactions in Graphene/MoS2 Photodetectors

Earle, Michael

Photodetectors and other photovoltaic devices have garnered significant interest in recent years for their applications in high-speed data transmission and data processing. Graphene, a single-atom-thick layer of carbon, has been demonstrated as an excellent material for fabricating smaller, more efficient photodetectors. Research has shown that a structure consisting of two layers of graphene with one layer of Molybdenum Disulfide (MoS2) in the middle shows hundredfold increased photoresponsivity over a single layer of graphene. However, the light-matter interactions in these graphene/MoS2 photodetectors are not well understood. Therefore, in this research, heterostructures of atomically-thin crystals of graphene and MoS2 were fabricated via mechanical exfoliation. Electrodes were attached to the crystals, and scans were performed on the sample to characterize the electronic structure of the heterostructure. Raman Spectroscopies and Photoluminescence (PL) tests were used to determine the thickness of the crystals. Raman Spectra and PL measurements indicate that in the sample fabricated, all three crystals are bilayer. In addition, a Line Scan of PL measurements shows a decrease in PL emissions when graphene and MoS2 are in direct contact. This phenomenon can be attributed to quenching – the movement of excitons from MoS2 to graphene, which generates an electric current. PL quenching suggests the presence of an electric field in the samples. Understanding the light-matter interactions in heterostructures can lead to further research in increasing the photoresponsivity of graphene-based photodetectors. In addition, the properties of graphene can be better understood by studying its interactions with MoS2.