Modification of charge transport in single layer MoS2

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Abstract

The ability to alter properties of 2D materials through defects engineering can open a new window in the device performance improvements as well as quantum electronics and photonics. Ion beam Irradiation is a controllable technique to modify the electrical and optical properties of 2D materials by defect creation. In this work, we used 5 - 7.5 keV helium and neon ions to modify charge transport in monolayer molybdenum disulfide (MoS2). Electrical characterization was performed in-situ immediately after ion beam irradiation. Raman and photoluminescence spectroscopy were implemented to characterize the effect of ion irradiation on monolayer MoS2. Our experiments demonstrate that the electrical properties of MoS2 strongly depend on the nature of the substrate and the ion beam used. Although 10^{12} - 10^{13} helium ions/cm^2 contribute to an increase in the current level [1], the same range of neon ions deteriorates the channel current. To examine the role of substrate few layers of hexagonal boron nitride (hBN) were used as an intermediate layer between MoS2 and SiO2 substrate. MoS2 samples on hBN show different electrical behavior during ion irradiation compared to the MoS2 flakes which were directly placed on SiO2.

References

[1] Hlawacek, G., Fekri, Z., Chava, P., & Erbe, A. (2020). In-situ Characterization of MoS2 Based Field Effect Transistors during Ion Irradiation. Microscopy and Microanalysis, 26(S2), 294-296.

Figures

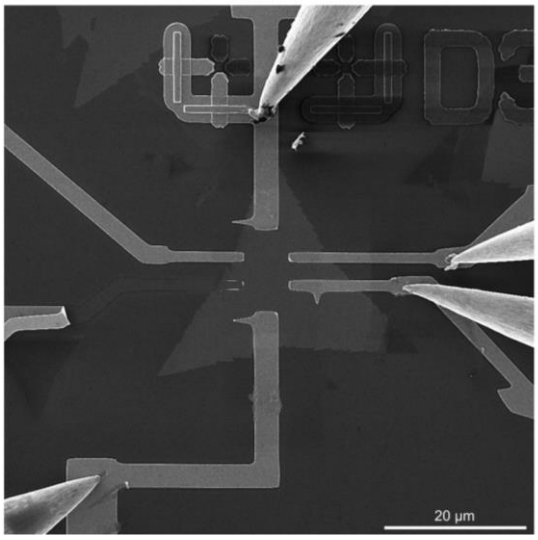

Figure 1 Image of MoS2 flake with contacts and probes after in-situ electrical characterization was taken with helium ion microscope [1].