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Raman shifts and in situ TEM electrical degradation of electron-irradiated monolayer MoS2.[1] WILLIAM M. PARKIN, ADRIAN BALAN, Univ of Pennsylvania, LIANGBO LIANG, Rensselaer Polytechnic Institute, PAUL MASIH DAS, Univ of Pennsylvania, MICHAEL LAMPARSKI, Rensselaer Polytechnic Institute, CARL NAYLOR, JULIO A. RODRIGUEZ-MANZO, ALAN T. JOHNSON, Univ of Pennsylvania, VINCENT MEUNIER, Rensselaer Polytechnic Institute, MARIJA DRNDIC, Univ of Pennsylvania — We report how the presence of electron-beam-induced vacancies affects first-order Raman modes and correlate this effect with the evolution of in situ TEM two-terminal conductivity of monolayer MoS_2 under electron irradiation. We observe a redshift in the E' Raman peak and a less pronounced blueshift in the A'$_1$ peak with increasing electron dose. Using energy-dispersive X-ray spectroscopy, we show that irradiation causes partial removal of sulfur and correlate the dependence of the Raman peak shifts with S vacancy density (a few percent), which is confirmed by first-principles density functional theory calculations. *In situ* device current measurements show exponential decrease in channel current upon irradiation. Our analysis demonstrates that the observed frequency shifts are intrinsic properties of the defective systems and that Raman spectroscopy can be used as a quantitative diagnostic tool to accurately characterize MoS_2-based transport channels.

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