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Excited-state interactions in monolayer MoS_2/graphene heterostructures CYRIELLE ROQUELET, Department of Physics and Chemistry, Columbia University, New York 10027, HEATHER HILL, Department of Physics, Columbia University, AREND VAN DER ZANDE, FAN ZHANG, JAMES HONE, Department of Mechanical Engineering, Columbia University, LOUIS E. BRUS, Department of Chemistry, Columbia University, TONY F. HEINZ, Department of Physics and Electrical Engineering, Columbia University — Recent progress in the formation of atomically thin 2-dimensional crystals by mechanical exfoliation and other synthetic techniques has led to the availability and study of various 2D materials other than graphene. Among them, molybdenum disulfide (MoS_2) has attracted particular attention. Although an indirect-gap material in the bulk, MoS_2 exhibits a direct gap in its monolayer form. Correspondingly, the material exhibits strong photoluminescence (PL), very sensitive to the environment. With the development of transfer techniques, it is now possible to create stacks of differing atomically thin materials. In this paper we apply this to investigate the influence of adjacent graphene layers on the PL of MoS_2 monolayers. Comparing the PL from MoS_2 on graphene with reference samples, we find that graphene induces strong quenching. Raman measurements of the graphene do not indicate the presence of any significant static charge transfer between layers. This suggests that the graphene layer provides efficient relaxation channels for the photoexcited MoS_2, rather than modifying its intrinsic properties. In this context, we discuss the relative contributions to PL quenching arising from excited-state charge and energy transfer processes.

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