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Ultrafast Terahertz Probe of Transient Evolution of Charged and Neutral Phase of Photoexcited Electron-hole Gas in Monolayer Semiconductor XUEFENG LIU, QINGQING JI, ZHIHAN GAO, SHAOFENG GE, JUN QIU, ZHONGFAN LIU, YANFENG ZHANG, DONG SUN, Peking Univ — We investigate the dynamical formation of excitons from photoexcited electron-hole plasma and its subsequent decay dynamics in monolayer MoS_2 grown by chemical vapor deposition using ultrafast pump and terahertz probe spectroscopy under temperature down to 78 K. The observed transient THz transmission can be fit with two decay components: a fast component with decay lifetime of 20 ps, which is attributed to exciton life time including the exciton formation and subsequent intraexciton relaxation; a slow component with extremely long decay lifetime of several ns which is attributed to long live dark exciton or localized exciton state. Further temperature and pump fluence dependent studies of the two decay components verify the above relaxation dynamics. The measured time resolved evolution of photoexcited carriers provides new opportunities in developing novel optoelectronic and excitonic devices based on monolayer transition-metal dichalcogenides.

Dong Sun
Peking Univ

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