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Probing the dark excitons in TMDC with two photon absorption spectroscopy ZILIANG YE, KEVIN OBRIEN, YU YE, MERVIN ZHAO, YING WANG, JUN XIAO, HANYU ZHU, XIAOBO YIN, YUAN WANG, XIANG ZHANG, University of California, Berkeley — When the transition metal dichalcogenide (TMDC) is reduced to the monolayer, its electronic bandgap is shifted from indirect type to direct type, resulting in a great enhancement in the photoluminescence efficiency. On the other hand, excitons usually play a very important role in determining the materials' optical properties, especially in the low dimensional forms. However, the exciton contribution has yet been experimentally identified in TMDC. Here we use the two photon absorption spectroscopy technique to probe the TMDC dark exciton transition, which has the complementary selection rule to bright exciton transition. By comparing the dark-bright exciton separation with the theoretical model, we confirm the extraordinarily large binding energy of exciton in two-dimensional TMDC. The identification of exciton contribution as well as the electronic band gap size would help to design the TMDC electronics and optoelectronics in the future.

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