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Temperature-dependent Exciton Dynamics of Superacid Treatment in Monolayers of the Metal Dichalcogenide MoS2

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ABSTRACT

To improve optoelectronic semiconductor materials, one of the most efficient research areas is the two-dimensional (2D) transition-metal dichalocogenides (TMDCs). It has been shown that organic nonoxidizing superacid bis(trifluoromethane)sulfonamide (TFSI) treatment of molybdenum disulfide (MoS_2) monolayer could uniformly enhance its photoluminescence by more than two orders of magnitude and also extend the lifetime of excitons. This could greatly improve the efficiency of the solar energy usage, but the mechanism behind it has not been fully understood. Extreme low temperatures (approximately 7K), which slow the surface exciton mobility, were applied to investigate the changes of treated MoS_2 monolayer surfaces. This approach also requires cover slip caps to protect samples from degrading in the vacuum and low temperature environment. Our results show that the defect stages of the MoS_2 surface still occur at low temperatures which differs from the previous mechanism proposed. To determine the true mechanism of superacid treatment of MoS_2 monolayer we will need further experiments.

KEYWORDS

2D Materials, molybdenum disulfide (MoS_2), optoelectronic semiconductors