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Excitonic quantum confinement modified optical conductivity of monolayer and few-layered MoS_2

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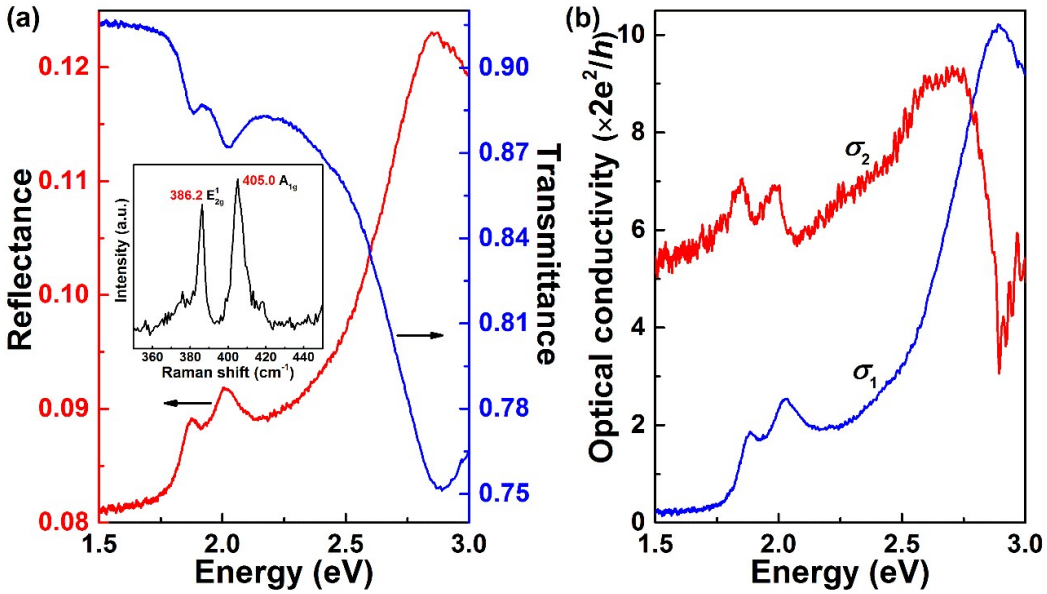

Fig. S1 (a) Measured reflectance and transmittance spectra and (b) derived complex optical conductivity $\sigma = \sigma_1 + i\sigma_2$ for a monolayer MoS_2 film. The inset in (a) shows the measured Raman spectrum of the sample under excitation by a 532-nm laser.

A monolayer MoS_2 film (1.0×1.0 cm^2) was fabricated on a sapphire (Al_2O_3) substrate of 0.35 mm thickness by chemical vapor deposition (CVD) method.[1] The Raman spectrum excited by 532 nm laser is shown in the inset of Fig. S1. Both E^1_{2g} and A_{1g} peaks are clearly observed, with a peak difference of 18.8 cm^{-1}, indicating that the prepared sample is indeed monolayer.[2] By using a UV-3600 double-beam spectrophotometer, the reflectance and transmittance spectra were measured, with results shown in Fig. S1a. One can find three peaks (dips) located at around ~1.87, ~2.00 and ~2.86 eV in the

reflectance (transmittance) spectrum, which correspond to the A, B and C excitonic absorption peaks of the MoS_2 film, respectively. According to Eqs. (3) and (4), the complex optical conductivity $\sigma = \sigma_1 + i\sigma_2$ can be derived, with results presented in Fig. S1b. It is seen that both values of σ_1 and σ_2 are positive.

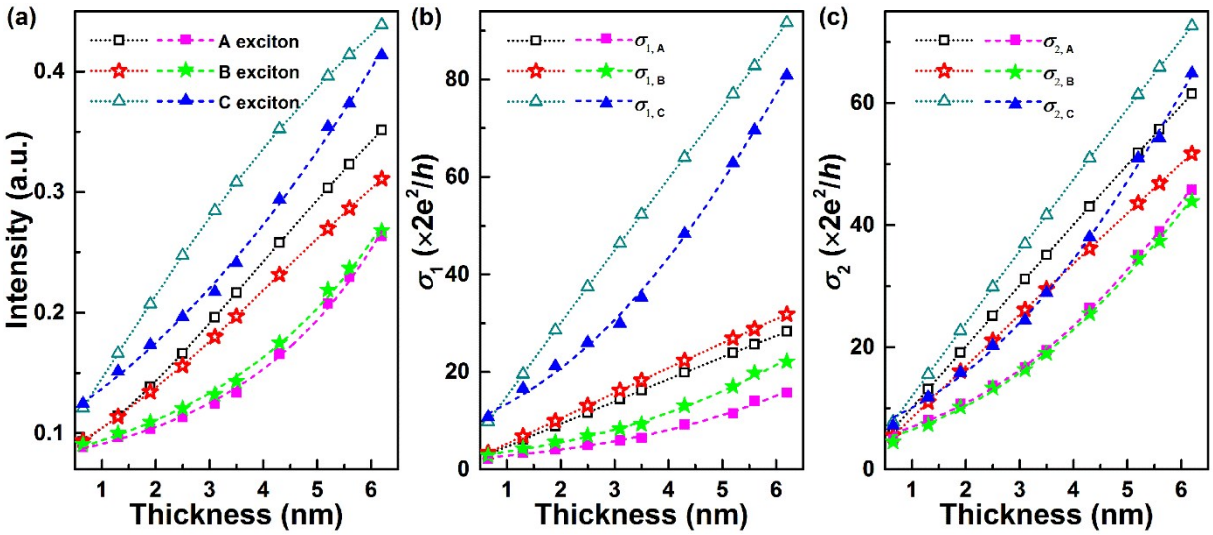

Fig. S2 (a) Excitonic reflectance intensity, and magnitudes of (b) $\sigma_{1,A}$, $\sigma_{1,B}$, $\sigma_{1,C,}$ (c) $\sigma_{2,A}$, $\sigma_{2,B}$ and $\sigma_{2,C}$. Hollow symbols are the calculated results by using the dielectric function of bulk MoS_2, and dotted lines are just drawn as a guide to the eye. Solid symbols are the results extracted from Fig. 2, *i.e.*, the calculated results by using the layer-dependent dielectric functions of MoS_2. Dashed lines are the fitting results by using Eq. (6).

References

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2 H. Li , Q. Zhang, C. C. R. Yap, B. K. Tay, T. H. T. Edwin, A. Olivier and D. Baillargeat, *Adv. Funct. Mater.*, 2012, **22**, 1385–1390.