Polarization-tuneable excitonic spectral features of atomically thin ReS_2

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Most studies on ReS2 spectroscopy have primarily focused on optical characterization, such as photoluminescence, absorbance, or reflectance spectroscopy. However, to fully understand the material's properties, a comprehensive investigation into its optoelectronic behaviour is necessary. In this study, we have conducted polarization-resolved photocurrent spectra measurements on few-layer ReS2 photodetectors at both room temperature and cryogenic conditions (14 K). Our findings reveal an exciton-like spectral feature with comparable photoresponse intensity to the main exciton lines reported in previous literature. Interestingly, this phenomenon was not observed in earlier photoluminescence measurements. Furthermore, we observed changes in the intensities of the three exciton features under linear polarized light, with each reaching maximum intensity at different polarization angles. The results from first-principles exciton calculations using the Bethe-Salpeter formalism support our experimental observations. These findings offer new insights into the study and utilization of exotic optoelectronic phenomena in ReS2-based devices.

References

[1] Vaquero, D., Arroyo-Gascón, O., Salvador-Sánchez, J., Alcázar-Ruano, P.L., Diez, E., Perez-Rodríguez, A., Correa, J.D., Domínguez-Adame, F., Chico, L., & Quereda, J. (2023). Polarization-tuneable excitonic spectral features in the optoelectronic response of atomically thin ReS2. *2D Materials, 11*.

Figures

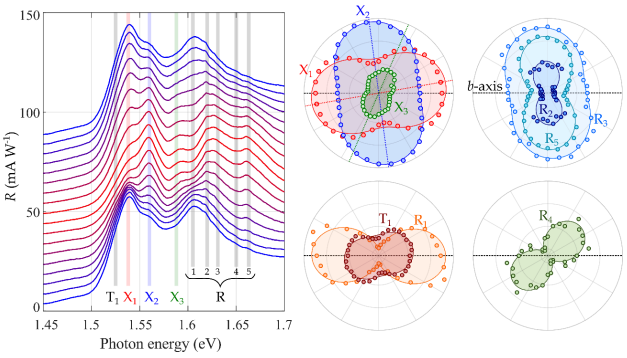

Figure 1: On the left, photocurrent spectra acquired for different angles of light polarization, from 0 to 170º relative to the b crystalline axis with Vsd = 5 V, Vgate = 45 V and a power density of 500 W m-2 . Consecutive spectra have been shifted vertically in steps of 5 mA W -1 for easier visualization. On the right, polar plots showing the modulation of the different spectral features as a function of the polarization direction, extracted from fittings to multi-Lorentzian curves