Photochemically doped $MoSe_2$ monolayers

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The discovery of graphene [1] has created a new class of materials, the so-called two-dimensional (2D) materials, with such strong optical properties. Transition metal dichalcogenides (TMDs) have the form of MX_2 (where M=Mo or W and X=S, Se, Te). The fact that these indirect band gap bulk crystals are transformed to direct band gap semiconductors at their monolayer form [2-3], makes them the forefront of research for many optoelectronic applications. Here, monolayers of molybdenum diselenide ($MoSe_2$) are investigated after photochemical doping with spectroscopic methods such as photoluminescence, differential reflectivity, Raman spectroscopy and spin valley polarization. This doping process includes UV laser irradiation at chlorine environment that leads to an e-density reduction (p-type doping) on $MoSe_2$, as predicted from theory [4]. The PL can be significantly enhanced after photochlorination and it is dominated by the neutral exciton emission (Fig.1a) as a consequence of the adsorption of electron-withdrawing chlorine adatoms that strongly suppress the electron concentration. Differential reflectivity measurements performed in the same monolayer are in remarkable agreement with the micro-PL data (Fig.1b).

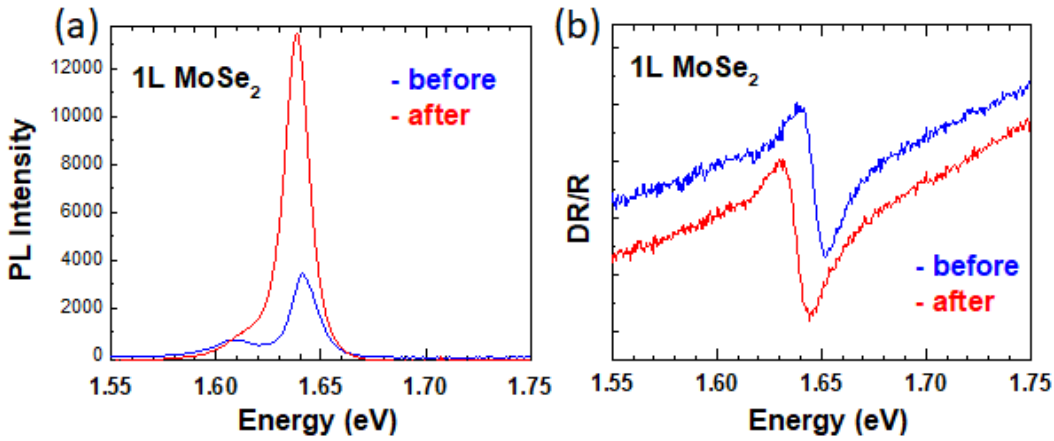

Figure 1: Photoluminescence **(a)** and differential reflectivity **(b)** spectra taken at 78K, before (blue curve) and after (red curve) photochlorination treatment. The PL is significantly enhanced after photochlorination and it is dominated by the neutral exciton emission.

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