Extremely high excitonic g-factors in $MoWSe_2$ alloy monolayers

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Monolayers (MLs) of semiconducting transition metal dichalcogenides (S-TMDs), e.g. $MoSe_2$ and WSe_2, are direct bandgap semiconductors characterized by very interesting optical and electronic properties. S-TMD alloys have emerged as materials with tunable electronic structures and valley polarizations [1]. In this work, we investigate magneto-optical properties of excitonic complexes in $Mo_xW_{1-x}Se_2$ ML encapsulated in hexagonal BN (hBN) with different ratios of Mo and W atoms. Under applied magnetic fields, the neutral exciton resonances in S-TMD MLs split into two circularly polarized components as a result of the Zeeman effect[2]. Using low-temperature photoluminescence (PL) experiments carried out in external out-of-plane magnetic fields up to 30 T, we extract the g-factors of the neutral (X) and charged (T) excitons presented in Fig. 1(a). The g-factors for the X transitions change gradually from about -4 up to about -10 for. This striking tunability is verified by first-principles calculations of the band structures. The calculated values of the g-factors (Fig.1 (b)) show a trend similar to the experimental ones, and also reveal an additional increase and decrease under application of the compressive or tensile biaxial strains, respectively. Alloying of S-TMD MLs is an efficient mechanism to enhance the g-factors of neutral excitons, up to values that have only been observed for interlayer excitons in TMDs heterostructures [3]. Due to the much simpler fabrication process of MLs compared to TMD HSs with specific twist angles, alloy MLs open new avenues as potential candidates for valleytronic and quantum devices [4].

References

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Figures

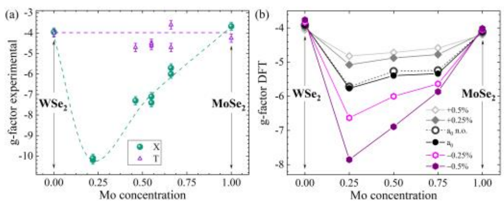

Figure 1: (a) Experimental values of the g-factors extracted for the neutral and charged excitons in $MoWSe_2$ MLs with different Mo/W ratios. (b) Exciton g-factors calculated from the first principles.