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Resonance Raman Scattering and Entanglement in Transition-Metal Dichalcogenide Semiconductor MoS_2 QDs

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Molybdenum disulfide (MoS_2) is widely used in optoelectronic devices due to its properties like high mobility, effective luminescence and strong binding energy. When 2D TMDs are reduced to 0D (zero dimensional) then we have a single MoS_2 quantum dot (QD), and an entirely special electronic property arises due to its quantum confinement effect which exhibits a larger direct band gap (3.96 eV) when compared to monolayer 2D sheets (1.89 eV)[1]. Based on these by molecular dynamics(MD) simulation we obtain the Raman spectra of one monolayer Mos_2 and we have compared the results with the experiment[2]. Next a quantum-statistical model for a three-level MoS_2 QD(Fig.2) interacting with two initially coherent radiation fields is presented and the theory of resonant Raman scattering in the presence of intense incident and scattered light waves is developed, using the quantum-mechanical master-equation approach. The non-radiative and radiative decay terms was included in the master equation, and then we solved the two-time system correlation functions. Numerical results for the resulting spectrum are presented for different cases (Fig.1).

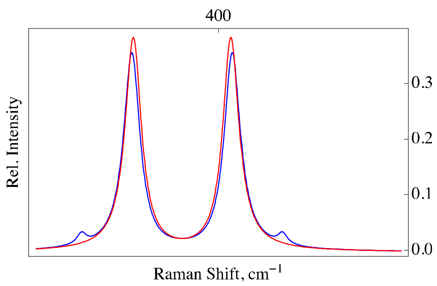

Fig. 1 Raman spectra of monolayer MoS_2 QD under two different strong fields, close to those previously determined in experiment[1]

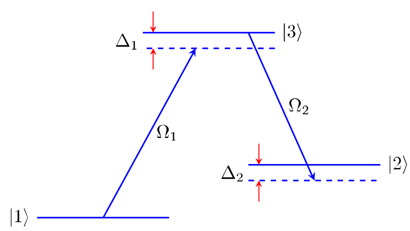

Fig. 2 MoS_2 QD energy levels, showing the absorption of the laser photon and emission of Raman photon, with their respective detunings

Finally to elucidate the quantum properties of MoS_2 QDs we investigated the entanglement generation between one, two and three MoS_2 QDs that could underlie at the composition of the MoS_2 triangular monolayer, and by coupling them to a photonic crystal nanocavity[3] we theoretically investigate the degree and dynamics of the entanglement.

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Surface relief formation in Yb doped As_2S_3–Se nanomultilayer structures

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Chalcogenide glasses and films are promising materials for application in optoelectronics and photonics. Nanomultilayer structures based on chalcogenide glasses attract much attention due to their property of direct surface relief formation under light or e-beam exposure with the ability to use them for optical element fabrication, holography, etc. The aim of this study is investigation of photo-stimulated processes during surface relief formation in Yb doped As_2S_3–Se nanomultilayer structures. The As_2S_3 glasses doped with Yb were prepared using melt-quenching technique. Modification of chalcogenide glasses by rare-earth elements changes their thermal, optical, structural and magnetic properties. Properties of As_2S_3:Yb glasses were studied using DSC measurements, Raman, optical spectroscopy. The main observed effect under the introduction of ytterbium into As_2S_3 is the change of relative concentration of the main and non-stoichiometric structural units characteristic for As_2S_3 glasses. Chalcogenide glasses are diamagnetics, in particular As_2S_3 glass. Introduction of Yb dopant changes magnetic properties of glasses. In constant magnetic field (B=6T) dependence of mass magnetization M=M(T), is observed which is characteristic for paramagnetics and ferromagnetics in paramagnetic region of temperatures and described by Curie-Weiss law. As_2S_3:Yb–Se nanomultilayer structures were