Electronic Supplementary Information (ESI)

Novel Colloidal MoS_2 Quantum Dot Heterojunctions on Silicon Platforms for Multifunctional Optoelectronic Devices

S. Mukherjee[1], R. Maiti[2], A. Katiyar[2], S. Das[3], S. K. Ray[2,#]

[1]Advanced Technology Development Centre, [2]Department of Physics, [3]School of Medical Science & Technology, IIT Kharagpur, Kharagpur

#corresponding author: physkr@phy.iitkgp.ernet

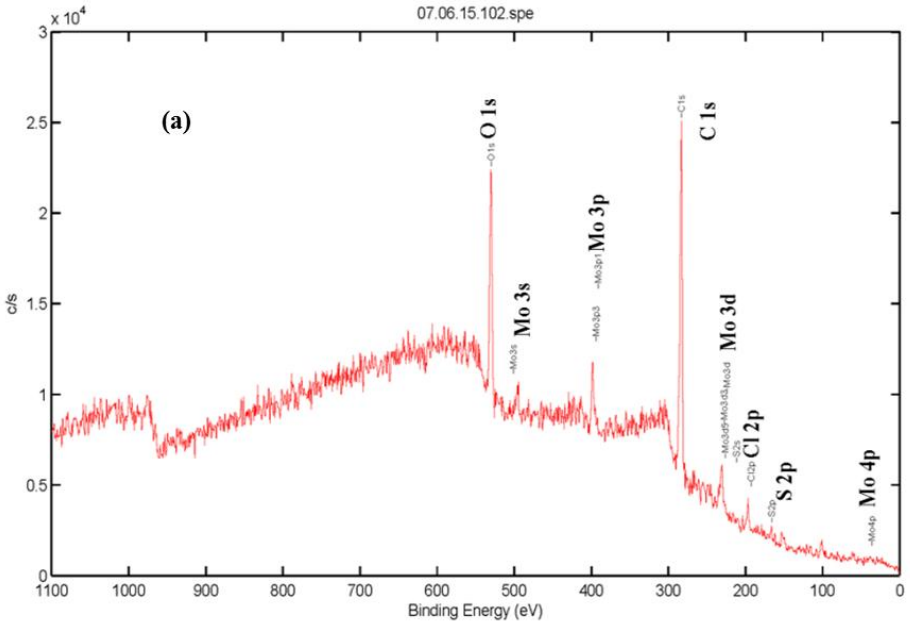

Fig. S1: Broad energy XPS survey spectrum of MoS_2 deposited on Si showing a weak but distinct signal of Cl 2p electrons. The presence of Cl as an impurity indicated an n-type doping in MoS_2 samples.

The excitonic Bohr radius of MoS_2 has been estimated using the following equation:

$$R_B = \frac{\hbar^2 \varepsilon}{e^2}\left[\frac{1}{m_e^*} + \frac{1}{m_h^*}\right] \qquad \text{..... (S.1a)}$$

Where, m_e^* and m_h^* are the effective masses of electrons and holes, respectively, $\hbar$ is the reduced Planck's constant, e is the electronic charge and ε is the relative permittivity of MoS_2. The effective masses and the dielectric permittivity have been considering as $m_h^* = 0.41m_o$ and

$m_e^* = 0.48m_o$, as m_o is the rest mass of the electrons and ~11, respectively. Using eq S.1, the excitonic Bohr radius has been found as ~23 nm.

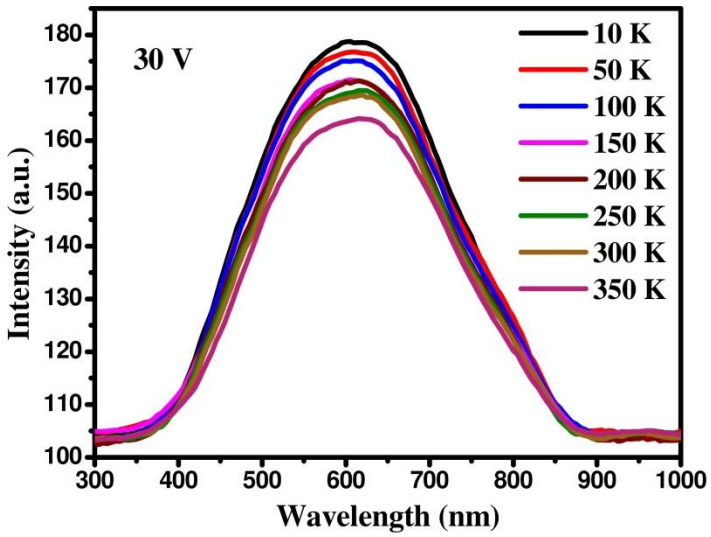

Fig. S2: (a) Temperature dependent electroluminescence (EL) spectra of Si/MoS_2 p-n heterojunction, recorded at 30 V applied bias.

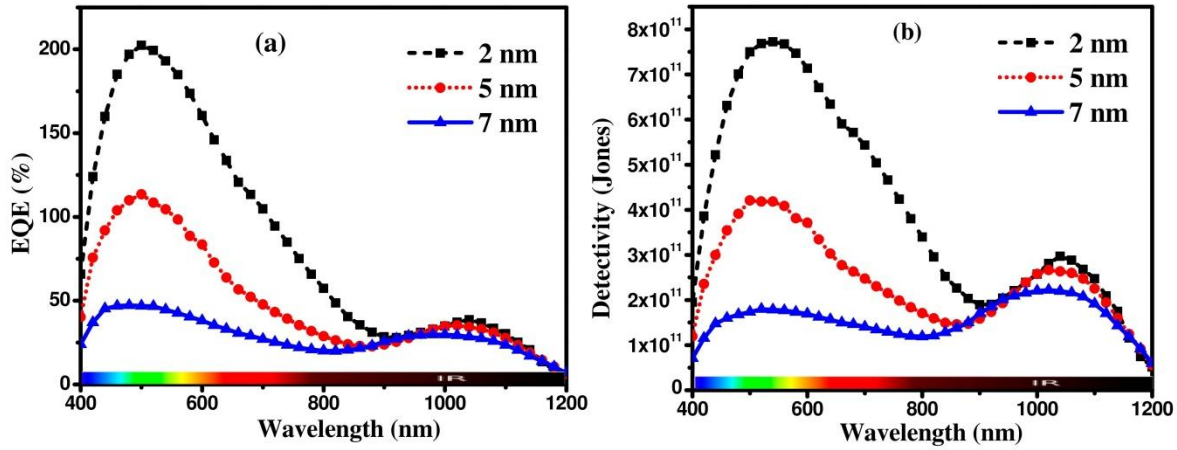

Fig. S3: (a) Spectral dependent external quantum efficiency (EQE) and (b) specific detectivity of different size MoS_2 quantum dot based devices exhibits PDs performances have been strongly dependent on the QDs size. All the spectra recorded at -2 V applied bias. The detectivity and the EQE both have been found ~4-fold improves with the reduction of QDs size from ~7 nm to ~2 nm.