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Investigation of the internal energy states in a DWELL structure based on PL and PLE

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We investigated the internal energy states in InAs QDs in a $In_{0.15}Ga_{0.85}As$ QW (DWELL) as well as the effects of QD size-variations inside QD ensemble by utilizing photoluminescence (PL) and photoluminescence excitation (PLE). As shown in Fig. 1, we can define the internal energy states and associated transitions from PL and PLE spectrum. Fig. 2 shows the variation of energy differences of each internal transitions extracted from PLE spectra observed with respect to the detection wavelengths detuned from the peak wavelength of the ground state of InAs QD, indicating the energy position of a wetting layer and the coupling effect between QDs and QW according to QD size. The energy differences $\triangle$H1, $\triangle$E1, $\triangle$E2 are almost independent of the detection energy, which means that energy spacings of QDs with different size are invarient. Transition 4 is deduced as that from the wetting layer due to the exact same shift with the detection energy shift. As the energy shift of Transition 5 has the same trend with those of QDs, we can infer this effect as the coupling between QDs and QW.

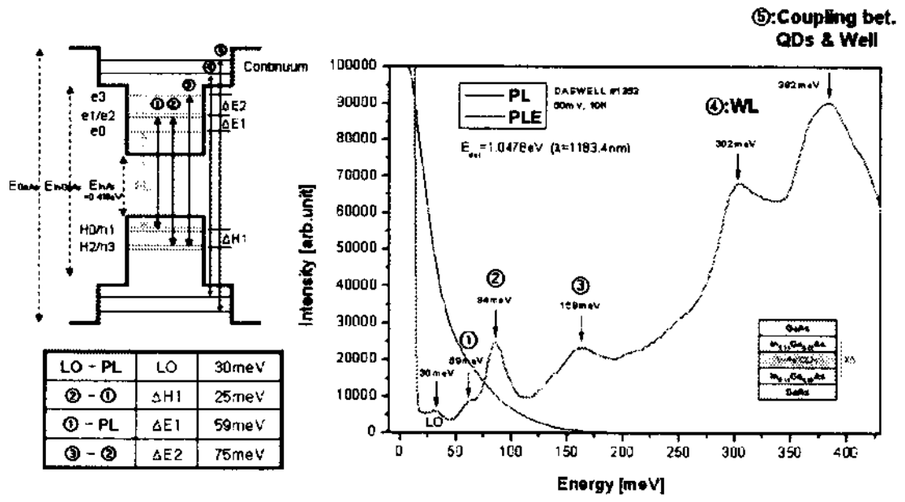

Fig. 1. Schematic of energy states of a DWELL

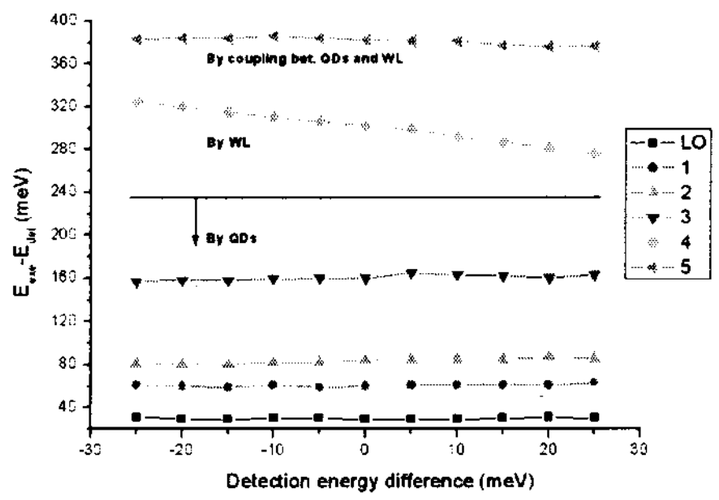

Fig. 2. Energy shifts vs. the detection energy