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Analysis of energy levels and defects in InAs/GaAs quantum dot system by using electrical measurements

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Self-assembled InAs/GaAs quantum dot (QD) systems have been great interested on the applications of optical devices such as laser diodes and quantum dot infrared photodetectors because of their discrete energy levels. The InAs and GaAs compound semiconductors are well-known materials and their growing methods are well developed. Thus, an accurate control for the hetero structures is available. Moreover, the difference of their lattice constants between InAs and GaAs is about 7 % and this property can make good QDs by using Stranski-Krastanov (S-K) growth mode during molecular beam epitaxy (MBE) or metalorganic chemical vapor deposition. From the reason, properties of this QD system have been investigated by many research groups. In this study, we find the confined energy levels of MBE grown InAs QD system by using capacitance-voltage (C-V) and deep level transient spectroscopy (DLTS) measurements. Indeed, we analyze also defects or interface states between hetero-junctions. To find the exact information such as defect densities and energy levels of QDs, DLTS measurements were done with varying the bias voltage and filling pulse width.