QUANTUM-SIZE SHIFT IN BAF_2/PBTE/BAF_2 MQW STRUCTURES REVEALED BY PHOTOLUMINESCENCE SPECTRA

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BaF_2/PbTe/BaF_2 multi-quantum well structures (MQW) were grown on cleaved (111) BaF_2 substrates by molecular beam epitaxy at a substrate temperature of 330 °C. The samples consist of 10 repetitions of 10 nm thick BaF_2 barriers and PbTe wells with variable width ranging from 5 to 20 nm. They were characterized by "in situ" reflected high energy electron diffraction (RHEED), x-ray diffraction and photoluminescence. The RHEED patterns show that, for this thickness range, the PbTe wells are, in fact, isolated islands. Therefore, the (222) x-ray diffraction shows only a low intensity and broad peak in the position where the PbTe peak should appear. The shift of the absorption edge observed in the photoluminescence spectra can be explained by considering the quantum-size confinement effect of a square well with infinite barriers, plus a remarkable deformation shift due to the thermal expansion coefficient difference, which takes place at cryogenic temperatures. These results show that it should be possible to obtain PbTe quantum dots immersed in BaF_2 by using this growth procedure and, in such structures, the expansion coefficient mismatch must be taken into account.