Magnetic Field Induced Quenching of Photoluminescence in $La_{0.7}Sr_{0.3}MnO_3$ Nanopillars Embedded in Self-assembled, Vertically-aligned Epitaxial $(ZnO)_{0.5}$:$(La_{0.7}Sr_{0.3}MnO_3)_{0.5}$ Nanocomposite Films

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Introduction

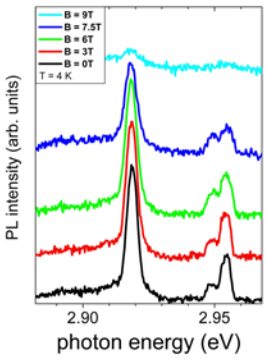
A great deal of research has been carried out in perovskite rare-earth manganites [1,2]. Among them, $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) is of particular interest due to its colossal magnetoresistive effect [3]. So far, studies in LSMO have mainly been focused on its bulk magnetic transport properties. Much less work has been carried out in nanostructures. Moreover, to our knowledge, there is no report on exploring low temperature photoluminescence (PL) measurements and the magnetic (B) field dependence in LSMO.

Experimental

Self-assembled vertically aligned epitaxial ZnO:LSMO nanocomposite films were grown on (001) $LaAlO_3$. The magneto-PL measurements in the UV regime were carried out at SCM3.

Results and Discussion

In our magneto-PL measurements, the B field direction was perpendicular to the LAO substrate. In the figure, we show the PL curves at five selected magnetic fields, 0, 3, 6, 7.5, and 9T, taken at 4 K. It can be clearly seen that the intensity of the peak at ~ 2.92eV is near constant at low fields. It starts to decrease at B > 6T, and almost disappears at 9T. Similar magnetic field dependence is also observed for other PL peaks. The exact origin of this B field induced quenching of PL intensity is not known at the present time. On the other hand, it is known that LSMO displays a magneto-strictive effect at high magnetic fields. As a result, the size of the unit-cell and thus induced strain effect varies with magnetic field, which, in turn, leads to a change in the Mn-O bond lengths and bond angles and modifies the Jahn-Teller field in the MnO_6 octahedra [4]. This modified Jahn-Teller field may give rise to the quenching of PL intensity.



Conclusions

Magneto-PL was carried out in $La_{0.7}Sr_{0.3}MnO_3$ nanopillars embedded in a self-assembled vertically aligned epitaxial ZnO:LSMO nanocomposite thin film. A magnetic field induced quenching of PL intensity is observed.

Acknowledgements

We thank P.C.M. Christianen for helpful discussions and D. Semenov for experimental assistance. The work at Sandia was supported by the DOE office of Basic Energy Science. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. The work at LANL was performed, in part, at the Center for Integrated Nanotechnologies, a U.S. Department of Energy, Office of Basic Energy Sciences user facility at Los Alamos National Laboratory (Contract DE-AC52-06NA25396) and Sandia National Laboratories (Contract No. DE-AC04-94AL85000). QXJ also acknowledges the support from the Los Alamos National Laboratory LDRD Program. A portion of this work was carried out at the National High Magnetic Field Laboratory, which is supported by the NSF and the State of Florida. JLMD acknowledges support from the European Research Council (ERC-2009-AdG 247276 NOVOX).

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