Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Electric field induced narrowing of exciton line width ILYA PONOMAREV, Naval Research Lab, Washington, DC 20375, LEV DEYCH, ALEXANDER LISYANSKY, Queens College of CUNY, Flushing, NY 11367 — Considering effects of electric field on the low temperature absorption line of quantum well excitons, we show [1] that, for moderate strength of the electric field, the main contribution to the field dependence of the line-width results from field induced modifications of inhomogeneous broadening of excitons. In the presence of disorder, the center-of-mass motion of the exciton in a QW structure is determined by the Schrödinger equation with random effective potential. The variance, $\sigma^2 = \left\langle V_{eff}\left(\mathbf{R}\right)^2 \right\rangle$ of the effective potential is an important characteristic determining the total exciton inhomogeneous line width. Application of the electric field in $z-$direction considerably modifies the excitonic wave functions, which in turn change the properties of the effective random potential. We show that in the Stark regime of moderate fields for the case of compositional disorder the potential variance changes with the field as$\sigma^{(\mathrm{com})2}(E) = \sigma^{(\mathrm{com})2}(0) - \alpha E^2$, while the contribution of the interface disorder to the variance is $\sigma^{(\mathrm{int})2}(E) = \sigma^{(\mathrm{int})2}(0) + \beta E + \gamma E^2$. Magnitudes and signs of α, β, γ depend on the thickness and interface qualities of the well. We show that under certain conditions one can observe narrowing of exciton spectral lines in electric field. This means that the electric field can become an important tool for identification of the disorder mechanism and monitoring the interface quality in the process of growth of the QW structures. [1], I. V. Ponomarev, L. I. Deych, A. A. Lisyansky, cond-mat/0408296.

Ilya Ponomarev
Naval Research Lab, Washington, DC 20375

Date submitted: 04 Dec 2004 Electronic form version 1.4