NON-RADIATIVE MAGNETOEXCITON RELAXATION ARISING IN SUPERLATTICE DUE TO LO-PHONON EMISSION

S. Dickmann, A. I. Tartakovskii, V. B. Timofeev, and V. M. Zhilin
Institute for Solid State Physics of RAS
142432 Chernogolovka, Moscow District, Russia

J. Zeman and G. Martinez
Grenoble High Magnetic Field Laboratory, MPI-FKF and CNRS
38042 Grenoble, Cedex, France

J. M. Hvam
Microelectronic Centre, The Technical University of Denmark
DK 2800 Lyngby, Denmark

A strong increase in the intensity of the peaks of excited magnetoexcitons (MEs) of the 2sHH and 3sHH types in the photoluminescence exciton spectra recorded for the ground ME (of the 1sHH type) has been found in a GaAs/$Al_{0.3}Ga_{0.7}As$ superlattice in strong magnetic field applied normal to the sample layers. The resonance profiles for both $\sigma^{\pm}$ polarizations have maxima close to the energy of the GaAs LO-phonon. This and some other features show that the observed effect is a manifestation of the magnetophonon resonance when strong relaxation of the excited MEs takes place via LO-phonon emission. Namely, when frequency ω_{LO} is equal to an appropriate multiple of the exciton cyclotron frequency

$$\omega_{LO} = NeB/\mu c \qquad (N = 1, 2, 3, ...)\,,$$

where μ is exactly **the reduced excitonic mass** for transverse motion in the layer plane. This seems to be the first observation the magnetophonon resonance for excitons (not for free electrons or holes as in Refs. [1-2]!). The similar phenomenon could manifest itself also in quantum wells or dots.

Studies of these non-radiative exciton transitions may provide the only way of the experimental measurement of the excitonic dispersion which is usually left aside in optical processes. The theoretical treatment developed in our paper allows us to extract certain information about the exciton-energy dependence on "in plane" wave-vector from experimental data. More detailed theory taking into account real multi-mode phonon spectrum in superlattice [3] has yet to be developed. We observed a peculiar "shoulder" structure in resonance profiles of all four types (2-3sHH MEs of $\sigma^{\pm}$ polarization) which is a manifestation of an additional folded phonon mode in the superlattice. We expect that with changing of the excited exciton peak position the non-radiative relaxation mediated by different dominant optic-phonon modes should occur. This change to another type of optic phonon explains the appearance of the shoulders in resonance profiles.

[1] D.J. Barnes *et al*, Phys. Rev. Lett. **66**, 794 (1991).
[2] T.A. Vaughan *et al*, Phys. Rev. B **53**, 16481 (1996).
[3] J. Menéndez, J. Lumin. **44**, 285 (1989).