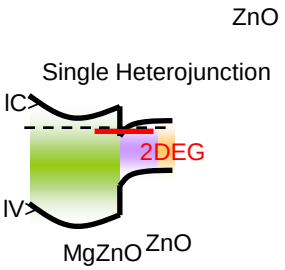
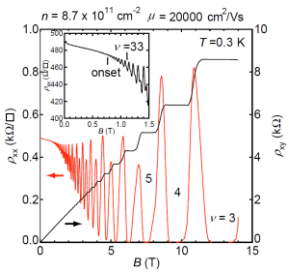
ZnO単一ヘテロ構造における磁気発光スペクトル

東北大WPI材料機構[1]，東北大金研[2*]，理研CMRG[3*]

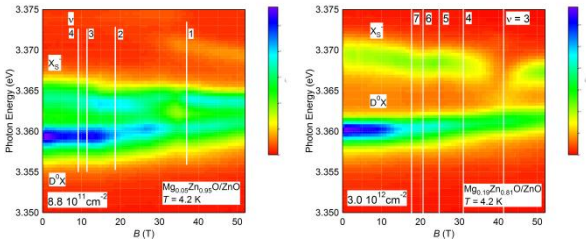
牧野　哲征[1]，塚崎　敦[2*]，瀬川　勇三郎[3*]

Introduction





Magneto-PL in ZnO heterojunctions

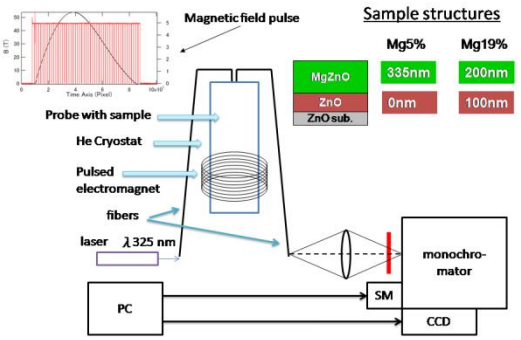


Motivations

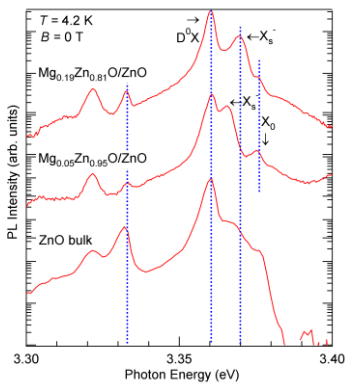
•Influence of the presence of 2DEG on the excitonic spectra.

•Can one observe PL peak originating from recombination of a photoexcited hole and 2DEG?

Experimental setup

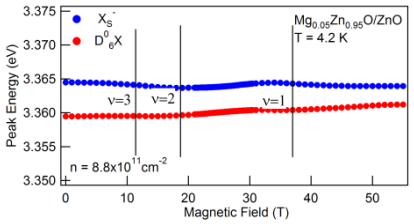


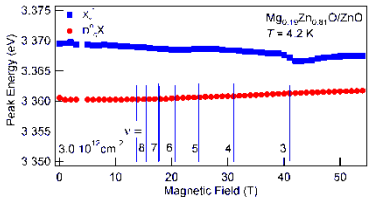
Typical PL spectra at 0T, 4.2K



1. X_S^- PL: radiative recombination related to 2-dim. electron system
2. D^0X is donor-bound-exciton PL at flat region.

Magneto-PL in MgZnO/ZnO SHJ



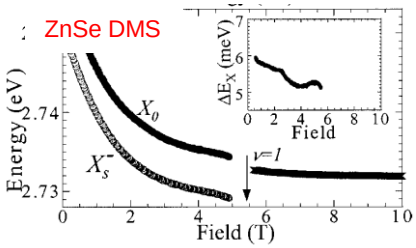


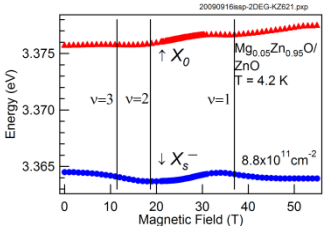
●D^0X PL energy is independent of Mg concentration. Typical diamagnetic shift.

●X_S^- : carrier-density-induced blueshift.

●Complicated field dependence（jump at integer filling factors）

Energy shift of trion from neutral exciton





$$\Delta E_X = \mu + E_{\mathrm{T}}^b$$

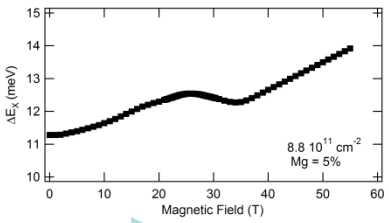
Fermi energy calculation

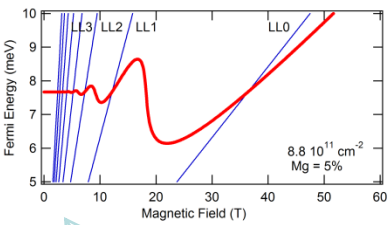
$$N_e = \int_{-\infty}^{\infty} g(E,B,T) f(E,\mu,T) dE$$

where

$$g(E) = \frac{1}{\pi l_B^2} \sum \left(\frac{\pi}{2}\Gamma_{i,N}^2\right)^{-1/2} \exp\left(-\frac{2(E-E_{1,N})^2}{\Gamma_{1,N}^2}\right),$$

$$f(E) = \frac{1}{\exp\{\beta(E-\mu)\}+1}$$





Experiment　　Theory

Conclusions

▪Magneto-PL study in ZnO SHJ's.

▪Observation of trion states from 2DEG.

▪Trion ionization energy follows magnetic-field-tunable Fermi energy for 8.8 10^{11} cm^{-2}.

▪Exciton to trion PL transfer at integer filling factors (ν).

▪FWHM enhancements at integer filling factors (ν).