CONDENSED MATTER SEMINAR SERIES

Piezoelectromagnetic effect in ferromagnetic (Ga,Mn)N layers

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Thursday, September 13
4:00 pm - Rm 184 NSH

Switching of magnetization direction between two stable states separated by an energy barrier is one of the most important processes for magnetic recording and information storage. This energetically costly scheme is conventionally done by applying an external magnetic field or spin polarized currents. An electric-field-control of magnetic anisotropy is a promising candidate to overcome the large energy budget of the conventional methods. We anticipate that this can be accomplished in (Ga,Mn)N, where owing to the inverse piezoelectric effect it is possible to manipulate the single ion magnetic anisotropy of the individual Mn species by electric field [1]. During the talk, direct magnetic observation of a strong reduction of the width of the hysteresis curve and a non-reversible magnetization switching for magnetic fields close to the coercive field for the ferromagnetic (Ga,Mn)N layers under the influence of external electric field will be presented.

[1] D. Sztenkiel, M. Foltyn, G.P. Mazur, R. Adhikari, K. Kosiel, K. Gas, M. Zgirski, R. Kruszka, R. Jakiela, Tian Li, A. Piotrowska, A. Bonanni, M. Sawicki, and T. Dietl, Stretching magnetism with an electric field in a nitride semiconductor, Nature Commun. 7, 13232 (2016).

Effects of Substrate Temperature on Magnetic Properties of (Ga,Mn)N grown by Molecular Beam Epitaxy

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Thursday, September 13
4:30 pm - Rm 184 NSH

The results of studies quantifying the impact of the growth temperature Tg on the structural and magnetic properties of (Ga,Mn)N will be presented [1]. Our Ga1-xMnxN layers have been grown by plasma assisted molecular beam epitaxy having the x value tuned from 0.2 to 10% solely by changing Tg between 700 and 590°C, respectively. Wide-ranged structural characterization by AFM, SIMS, TEM, and XRD do not reveal any crystallographic phase separation or precipitations. XANES spectroscopy supported by DFT modelling and SQUID magnetometry points to the predominantly Mn3+ configuration for which the ferromagnetic phase due to superexchange spin-spin coupling is observed in layers with $x > 5\%$ at $3 < T < 10$ K. Fine substrates' surface temperature mapping shows that the magnitudes of both x and Curie temperature TC correlate with local Tg. The observed 10°C variation of Tg across 1" substrate leads to 40% dispersion of TC. It will be shown that two different methods of TC determination allow for quantification of Mn ions distribution within the material.

[1] K. Gas et al., Impact of substrate temperature on magnetic properties of plasma-assisted molecular beam epitaxy grown (Ga,Mn)N, J. Alloys Compd. 747, 946 (2018).

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