Towards electrical control of magnetization in (Zn,Mn)Te:N

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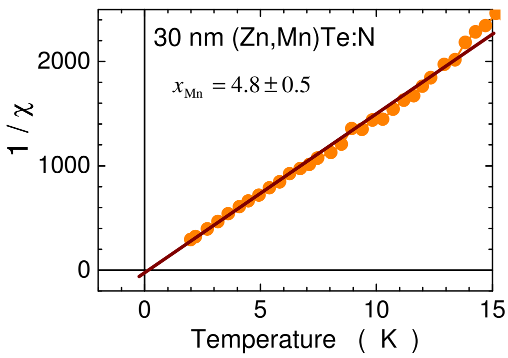

Inverse volume magnetic susceptibility as a function of temperature pointing to the Curie-Weiss temperature $T_{CW} = 0 \pm 0.2$ K and total Mn concentration of 4.8%.

The interplay between magnetic and electric properties of magnetic layers is of considerable interest owing to the perspective of exploiting the underlying mechanisms for the next generation of devices for information storage and processing. Recently, by detecting magnetization changes in phase with an applied electric field we observed that the magnitude of single-ion magnetic anisotropy of Mn^{3+} ions in GaN can be controlled by magnetoelectric coupling driven by the inverse piezoelectric effect that stretches the elementary cell along the wurtzite *c*-axis [1]. In this work, using the same detection scheme, we study magnetic properties of (Zn,Mn)Te:N layers as a function of the gate electric field in metal-oxide-semiconductor (MOS) structures through the modulation of hole density. Since the pioneering work of Ohno *et al.* [2], electrical control of ferromagnetism was observed in the MOS structures of (Ga,Mn)As [3] as well as in cobalt layers at room temperature [4]. Similarly, in (Cd,Mn)Te in a *p-i-n* diode configuration, it was possible to control hole concentration, by electric field and by illuminating the sample with photons of energy larger than the band gap of the barrier [5].

The samples in which we attempt to tune magnetic coupling via electric field are composed of (Zn,Mg)Te:N/(Zn,Mn)Te:N heterostuctures grown on GaAs substrates in that order by molecular beam epitaxy. Samples are covered by HfO_2 dielectric oxide layers grown by an atomic layer deposition and Cr/Au gates deposited by thermal evaporation. Submilimeter-size capacitors have been defined for ~160 nm thick oxide layer, reaching capacity of 0.1 μF/cm^2. Up to now, the samples have been characterized by photoluminescence, magnetotransport, and magnetic measurements. As shown in the figure, in the exemplified p-(Zn,Mn)Te:N layer intrinsic antiferromagnetic interactions, specific to Mn^{2+} in II-VI host, got compensated by nitrogen-derived hole-mediated ferromagnetic coupling.

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The work is supported by the Narodowe Centrum Nauki through MAESTRO (2011/02/A/ST3/00125)