Static magnetic order on the triangular antiferromagnet Li_xNiO_2 with $x \leq 1$

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In the rhombohedral $LiNiO_2$ lattice with space group $R\overline{3}m$, the NiO_2 plane and the Li layers form alternating stacks along the c_H-axis in a hexagonal setting. In the NiO_2 planes, Ni ions form a two-dimensional triangular lattice (2DTL) by a network of edge-sharing NiO_6 octahedra. Since the 2DTL planes are separated by nonmagnetic Li layers and Ni^{3+} is in a low spin state ($t_{2g}^6 e_g^1$) with S=1/2, $LiNiO_2$ is thought to be an ideal material for elucidating frustrated magnetism on a half-filled 2DTL. Thus far, there has been no long-range magnetic order detected down to the lowest T investigated, although the susceptibility (χ) measurements show a spin-glass-like anomaly around 10 K. Both heat capacity and NMR measurements, however, suggest a spin-liquid state with short-range ferromagnetic (FM) correlations [1]. A μ^+SR experiment has also indicated the absence of static magnetic order down to 2 K as well as showing the existence of fast fluctuating moments [2]. Recent neutron diffraction (ND) experiments have proposed the possibility of local orbital ordering of Ni^{3+} into three sublattices [3].

In order to gain elucidation upon the nature of the NiO_2 plane and solve the current confusing situation, we have investigated the variation of magnetism with the spin concentration on the 2DTL. For $LiNiO_2$, Li ions are known to be easily deintercalated by electrochemical reaction down to $x \sim 0$. Here, we report the microscopic magnetic nature of Li_xNiO_2 with x=1, 2/3, 1/2, 1/3, and 0.1 by means of μ^+SR, and the existence of a variety of phases as a function of x in Li_xNiO_2. In particular, the appearance of static magnetic order, most likely IC-SDW order for Li_xNiO_2 with x=1 and 2/3, suggests the AF ground state of the NiO_2 plane.

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