Effect of proton irradiation on magnetic properties of two-dimensional Ni(II) molecular magnet

Dominik Czernia,[1] Piotr Konieczny,[1] Ewa Juszyńska-Gałązka,[1] Janusz Lekki,[1] and Anabel Berenice González Guillén[2]

[1] *Institute of Nuclear Physics Polish Academy of Sciences, PL-31342 Krakow, Poland*
[2] *Faculty of Chemistry, Jagiellonian University, PL-30387 Krakow, Poland*

The broad capability of the molecular magnetic materials emerges from the variety of available systems with unique properties that can be altered by external stimuli such as temperature, pressure, light irradiation, or sorption of guest molecules. Although not popular in the field of molecular magnetism, ion irradiation is the other approach for tailoring the material's parameters. Energetic particles expose solids to the high-density local energy deposition, leading to non-linear and threshold effects that may create new materials with novel properties.

In particular, the irradiation-induced defects may give rise to the magnetism in initially non-magnetic materials and modify the magnetic properties of a system with a non-zero magnetic moment, especially when strong magneto-structural correlations are present. The studies of the response of thin films and bulk samples to ion irradiation show there is a possibility to alternate such parameters as the critical temperature, g-factor, or coercivity by energetic particles deposition. However, no systematic studies can be found regarding the effects of ion irradiation on molecular magnetic materials.

Here we examine the magnetic properties of 2D coordination polymer based on nickel sulfate and a 1,3-phenylenediamine ligand that was irradiated with 1.9 MeV protons using fluences ranging from $5{\cdot}10^{13}$ p·cm^{-2} to $2{\cdot}10^{15}$ p·cm^{-2}. The samples irradiated with the high fluence showed an increase in magnetization saturation up to 200 percent and the reduced coercive field to even 10 percent of the reference level. Simultaneously, the critical temperature remained the same (T_c = 24.5 K) regardless of the received radiation dose. The IR spectroscopy showed that the overall structure of the studied compound was preserved after proton irradiation, and only minor changes are present in the local structure.