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Manipulating the magnetism of $NiPS_3$ via organic ion intercalation

D. Tezze[1], J. Pereira[1], F. Calavalle[1], Y. García[1], B. Martín-García[1], M. Gobbi[1,2,3], L. E. Hueso[1,3]

[1]CIC nanoGUNE BRTA, 20018 Donostia-San Sebastian, Spain
[2]Materials Physics Center CSIC-UPV/EHU, 20018 Donostia-San Sebastian, Spain
[3] IKERBASQUE, Basque Foundation for Science, 48013 Bilbao, Spain
d.tezze@nanogune.eu

Intercalation of layered materials is as a powerful fabrication and processing tool to modify the optical, electronic and magnetic properties of the host lattice [1-3]. In this study, we performed an electrochemical intercalation of different alkylammonium cations into $NiPS_3$ bulk crystals (Fig. 1a). Moreover, we explored an interlamellar alkylammonium-$Co(Cp)_2^+$ exchange, which is thermodynamically favored for $NiPS_3$. X-ray diffraction spectra show the appearance of new (00l) peaks' families at lower 2θ angles, attributed to an increase of host lattice's interlayer distance (Fig. 1b). Raman spectra reveals clear fingerprints of the intercalation. Finally, magnetization measurements demonstrate a dramatic change in the $NiPS_3$ magnetic properties, with the suppression of the pristine antiferromagnetism and the emergence of ferrimagnetism or paramagnetism (Fig. 1c), depending on the guest specie. Our results indicate that molecular intercalation is a promising route to tailor the magnetic properties of layered materials.

References

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Figures

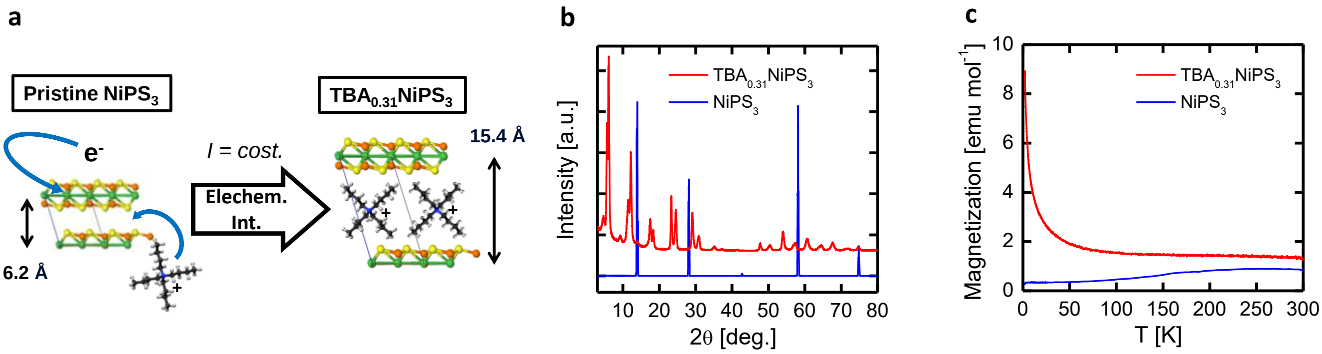

Figure 1: (a) Schematic of the electrochemical intercalation. Upon reduction of $NiPS_3$ host lattice, TBA^+ cations are readily intercalated in between the Van der Waals gaps. (b) XRD patterns of pristine $NiPS_3$ and TBA^+ int. $NiPS_3$. (c) Magnetization vs. temperature of pristine $NiPS_3$ and TBA^+ int. $NiPS_3$ at 500 Oe. Pristine-antiferromagnetism is replaced by paramagnetism.