Characterization of the Delafossite solid solution series $NaYb_{1-x}Lu_xS_2$

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Delafossite Materials were already investigated in the 1970s [1]. Lately some compounds of this structure family attracted considerable interest in quest of a unique magnetic ground state – the quantum spin liquid (QSL) state. Delafossites with trivalent rare earth metal ions on a regular triangular sublattice (see Figure 1) provide a perfect geometrical basis for this kind of frustrated spin system. Indeed, no magnetic order was found in Yb-Delafossites down to 260 mK [2,3], whereas other rare earth metal Delafossites order in the low tempertaure regime [4].
To investigate the interplay of the electron spins with respect to the magnetic properties in detail, we substituted the Yb^{3+} ions in $NaYbS_2$ with non magnetic Lu^{3+} to dilute the magnetic sublattice. As the spin-spin interactions are influenced by the geometric confinements of the structure we had a detailed look on the structural parameters before determining the magnetic susceptibility and the electron spin resonance (ESR) properties. We characterized the samples of the solid solution series $NaYb_{1-x}Lu_xS_2$ with $0 \le x \le 1$ with respect to their chemical composition, analyzed their structural parameters in single crystal and powder X-ray diffraction experiments and evaluated the structural changes (see Figure 2 for the lattice parameters) throughout the whole substitution series.

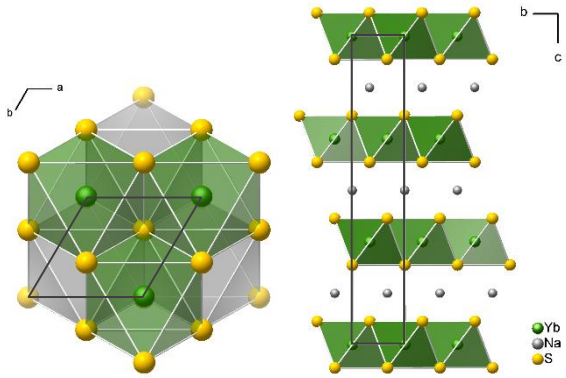

Figure 1: Crystal structure of $NaYbS_2$ in $R\bar{3}m$. The unit cell is depicted in dark grey.

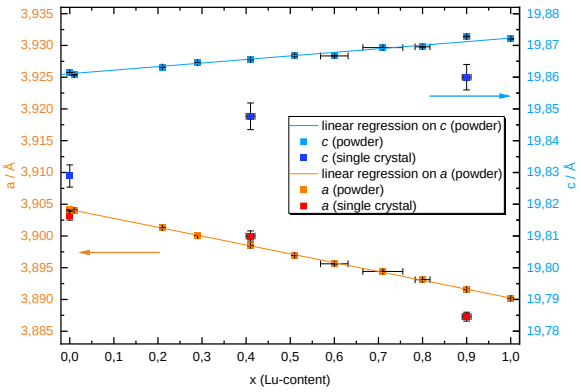

Figure 2: Refined lattice parameters of $NaYb_{1-x}Lu_xS_2$ samples derived from powder and single crystal data.

[1] A. W. Verheijen, W. J. P. V. Enckevort, J. Bloem, L. J. Giling, *J. Phys. Colloq.* **1975**, *36*, 39–45.
[2] M. Baenitz, Ph. Schlender, J. Sichelschmidt, Y. A. Onykiienko, Z. Zangeneh, K. M. Ranjith, R. Sarkar, L. Hozoi, H. C. Walker, J.-C. Orain, H. Yasuoka, J. van den Brink, H. H. Klauss, D. S. Inosov, Th. Doert, *Phys. Rev. B* **2018**, *98*, 220409.
[3] W. Liu, Z. Zhang, J. Ji, Y. Liu, J. Li, X. Wang, H. Lei, G. Chen, Q. Zhang, *Chin. Phys. Lett.* **2018**, *35*, 117501.
[4] G. Bastien, B. Rubrecht, E. Häußler, P. Schlender, Z. Zangeneh, S. Avdoshenko, R. Sarkar, A. Alfonsov, S. Luther, Y. A. Onykiienko, H. C. Walker, H. Kühne, V. Grinenko, Z. Guguchia, V. Kataev, H.-H. Klauss, L. Hozoi, J. van den Brink, D. S. Inosov, B. Büchner, A. Wolter-Giraud, T. Doert, *SciPost Phys.* **2020**, *9*, 041.

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