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# Synthesis and characterization of mixed-valence LuFe<sub>2</sub>O<sub>4-&delta;</sub>: Effect of stoichiometry &delta;

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### Abstract content <br/> &nbsp; (Max 300 words)<br/> dry-<a href="http://events.saip.org.za/getFile.py/atarget="\_blank">Formatting &<br/> &classed chars</a>

LuFe<sub>2</sub>O<sub>4</sub> exhibits a unique mixed-valence superstructure arising from charge-ordering (CO) within the lattice. The unit cell consists of a characteristic stacking of bi-layers, in which Fe is configured in a triangular network. This results in charge and spin frustration in the material, with a resulting plenitude of degenerate magnetic-electronic ground states. Furthermore the Fe is coordinated with oxygen in a trigonal bi-pyramidal polyhedron, a rather unusual co-ordination geometry for inorganic compounds. This mixed-valence characteristic within the bi-layers has been claimed to give rise to a dipole moment, i.e., ferroelectric effects arising from the CO. However such claims of electronically driven CO are under dispute [1]. Recent work has also demonstrated remarkable oxygen storage capacities in this compound [2]. Previous studies have indeed shown that the Fe<sup>2+</sup>/Fe<sup>3+</sup> ratio and magnetic ordering temperature T<sub>N</sub> are influenced by the oxygen stoichiometry [3-4]. We will report our investigations of the effect of oxygen stoichiometry on the CO and magnetic-electronic properties of LuFe<sub>2</sub>O<sub>4-delta;</sub>, from a comparison of stoichiometric and oxygen deficient samples. Such samples of LuFe<sub>2</sub>O<sub>4-delta;</sub> of varying oxygen stoichiometry, delta;, have been synthesised by solid state reaction as a polycrystalline powder. These have been characterised by xray diffraction, <sup>57</sup>Fe Mouml;ssbauer-effect spectroscopy (MES), SQUID magnetometry and TGA chemical analysis. Using different masses for the overall starting mixture has a radical effect on the purity of the as-synthesised LuFe<sub>2</sub>O<sub>4-delta;</sub> sample. Magnetisation measurements show that T<sub>N</sub> is confined to 245-250 K for the synthesised samples, albeit with quite significant differences in the magnetisation-temperature envelopes. Variable cryogenic temperature MES measurements are used to compare the effect of oxygen content on both the CO and magnetic hyperfine structure.

- [1]. Angst M, Phys. Status Solidi RRL 7, 375 (2013).
- [2]. Hervieu M et al., Nature Materials 13, 74 (2013).
- [3]. Yang HX et al., J. Phys. Condens. Matter 24, 435901 (2012).
- [4]. Wang F et al., J. Appl. Phys. 113, 06 (2013).

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#### Main supervisor (name and email)<br/>-br>and his / her institution

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## Would you like to <br > submit a short paper <br > for the Conference <br > Proceedings (Yes / No)?

Yes

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