

## Synthesis and physical properties of $\text{Ca}_{1-x}\text{RE}_x\text{FeAs}_2$ with $\text{RE} = \text{La} \sim \text{Gd}$

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In this study we report the synthesis and characterization of five new related to the  $\text{Ca}_{1-x}\text{RE}_x\text{FeAs}_2$  112 iron-based superconductors with  $\text{RE} = \text{Ce}, \text{Pr}, \text{Nd}, \text{Sm}, \text{Eu}$  and  $\text{Gd}$ . Samples were prepared using the high pressure synthesis technique, cubic-anvil type cell, applying 2 GPa and 1000° C. From XRD analysis the 112 phase was successfully observed in all samples, with some impurities of  $\text{FeAs}$  and  $\text{FeAs}_2$ . From magnetic susceptibility measurements the  $\text{Nd}, \text{Sm}, \text{Eu}$  and  $\text{Gd}$  doped samples exhibited diamagnetism suggesting superconductivity, while the  $\text{Ce}$  doped sample showed a paramagnetic like behaviour without any traces of superconductive transition down to 2 K. The critical temperatures evaluated from the magnetic susceptibility ( $T_{\text{c-mag}}$ ) for the  $\text{La-}, \text{Pr-}, \text{Nd-}, \text{Sm-}, \text{Eu-},$  and  $\text{Gd-}$ doped samples are 24.5, 13.2, 11.9, 11.6, 9.3, and 12.6K, respectively.  $T_{\text{c-mag}}$  progressively decreases with decreasing the ionic radii of the substituted RE (Fig.1); Those results are in agreement with the resistivity measurements too; suggesting a general decreasing of  $T_{\text{c}}$  with smaller RE substituted atoms. Distance between Fe planes,  $d_{\text{Fe-Fe}}$ , evaluated from the XRD patterns of single crystals decreases in agreement with the ionic radii of the substituted RE, only the  $\text{Eu}$  doped sample show an unexpected value, suggesting the presence of the  $\text{Eu}^{2+}$  ions.

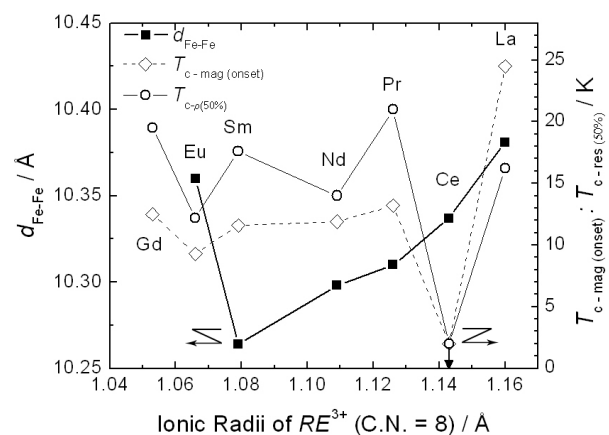


Fig. 1:  $d_{\text{Fe-Fe}}$ ,  $T_{\text{c-mag}}$ , and  $T_{\text{c-res}}$  as functions of ionic radii of the  $\text{RE}^{3+}$  ions in a coordination number (C.N.) of 8, for the  $(\text{Ca},\text{RE})\text{FeAs}_2$  samples. Straight and dashed lines are only guides for the eyes.



## Highlights 2014

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