

Doping and substitutions in LnFeAsO single crystals grown at high pressure: influence on superconducting properties and structure

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An overview of the basic superconducting properties measured on single crystals of LnFeAsO (Ln = La, Pr, Nd, Sm, Gd) will be presented. LnFeAsO single crystals were grown from NaCl/KCl and NaAs/KAs fluxes at high-pressure of 30 kbar. Application of NaAs flux led to mm size of LnFeAsO crystals. Superconductivity was induced by partial substitution of O by F, Sm by Th, Fe by Co, As by P and by oxygen vacancies. By comparing our experimental data for (Sm,Th)FeAsO, SmFeAs(O,F) and SmFe(As,P)O it was found that the pnictogen height is a key factor that determines the superconducting critical temperature. In all superconducting samples after doping the charge-reservoir SmO layer moves closer to the superconducting FeAs layer which facilitates electron transfer. In SmFe(As,P)O samples superconductivity appears only after high pressure treatment which generates oxygen deficiency and induces electron doping. SmFe(As,P)O samples without O deficiencies are non-superconducting however spin density wave is suppressed. The magnetic and transport properties studies of SmFeAs(O,F) single crystals reveals a promising combination of high and nearly isotropic critical current densities exceeding 10^6 A/cm².¹

¹P. J. W. Moll, et al., Nature Materials **9**, 628 (2010).