High pressure synthesis and properties of oxygen-deficient oxypnictide superconductors *Ln*FeAsO$_{1-y}$

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We have utilized a high-pressure (HP) technique to synthesize a series of newly-discovered iron (nickel)-based superconductors. For the *Ln*FeAsO-based superconductors (*Ln* = lanthanide), we show that the introduction of oxygen (O)-deficiency in the *Ln*O layers, achievable only through HP process, is an effective way to dope electron carriers into the system, yielding the superconducting transition temperature (T_c) comparable with those for F-substituted counterpart. T_c's higher than 50K is observed for heavier *Ln*'s (Nd, Sm, Gd, Tb, and Dy). The effects of O-deficiency, variation of *Ln* ions, and the external pressure on T_c are examined. All the experimental data indicate strong correlation between the crystal structure and the superconductivity of the oxypnictide superconductors. We also show that T_c in La-based 1111 is enhanced when we incorporate $La(OH)_3$ as a starting material. The highest T_c reaches 35 K, almost equal to the highest record reported so far in the La-based 1111 system (Wei Lu *et al*., Solid State Comm.**148** (2008) 168-170). Similarly, T_c of Ce-based 1111 can be increased up to 46K. The increase of T_c is accompanied by the shrinkage of the crystal lattice, which causes chemical pressure on the Fe–As plane.