Highlights

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Structural strain and competition between charge density wave and superconductivity in La(Fe,Mn)As($O_{0.89}F_{0.11}$) compounds

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Selected members of the La(Fe, Mn)As(O0.89F0.11) system were analyzed using high-resolution synchrotron x-ray powder diffraction. The tetragonal to orthorhombic structural transition is progressively recovered in the optimally electron-doped La(Fe,Mn)As($O_{0.89}F_{0.11}$) phase by very light Mn substitution; at the same time, superconductivity is suppressed whereas magnetic ordering is restored. Distinct incommensurate satellite peaks develop within different thermal ranges and mark the occurrence of charge density waves characterized by distinct propagation wave vectors, as well as multiple incommensurate structural transitions. In particular, some of these peaks arise in conjunction with the structural transformation process, disappearing after the completion of the dissymmetrization, thus suggesting that the structural transformation is possibly driven by charge degrees of freedom. The thermal evolution of satellite reflections observed at Q ∼ 1.93 Å–1 indicates a strong competition between the charge density waves and the superconductive state. A phase diagram of the La(Fe,Mn)As($O_{0.89}F_{0.11}$) system is drawn on the basis of the structural, magnetic, and electronic properties of the analyzed samples

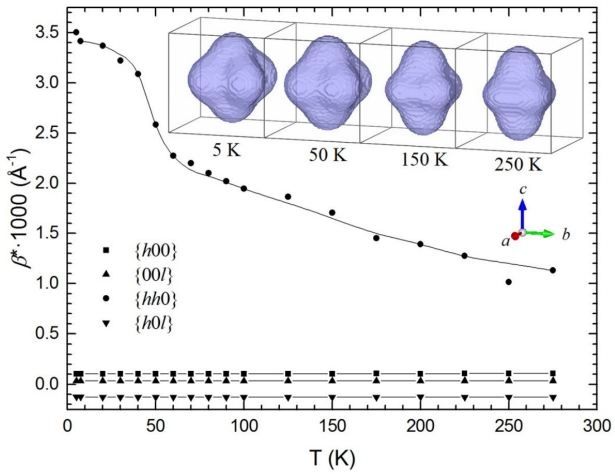

Fig. 1: Thermal evolution of the tetragonal anisotropic strain parameters obtained by Rietveld refinement; β represents the integral breadth of the diffraction line profile. The inset shows the corresponding tensor surfaces calculated at selected temperatures.

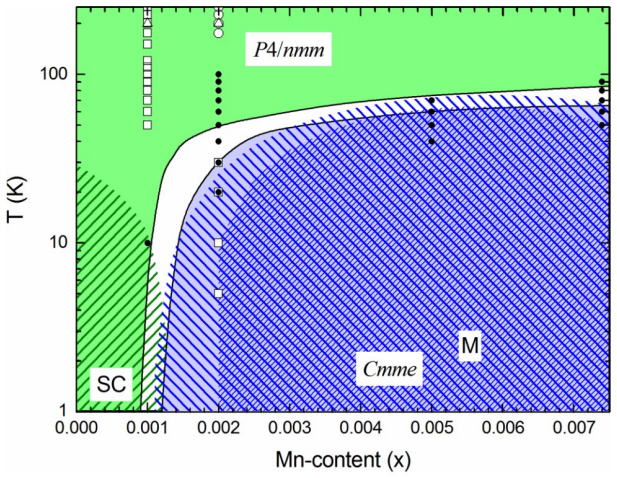

Fig. 2: Phase diagram of the La($Fe_{1-x}Mn_x$)As($O_{0.89}F_{0.11}$) system; the magnetic phase field is drawn for both a magnetic volume fraction equal to 50% (sparse pattern) and 100% (dense pattern); temperatures at which incommensurate peaks are observed are also indicated by points.