Strong Momentum-Dependent Doping-Induced Renormalizations of Optical Phonons in single Crystals of SmFeAs(O$_{1-x}$F$_y$)

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We report inelastic x-ray scattering experiments on the lattice dynamics in SmFeAsO and superconducting SmFeAsO$_{0.6}$F$_{0.35}$ single crystals. Particular attention was paid to the dispersions along the [100] direction of three optical modes close to 23 meV, polarized out of the FeAs planes. Remarkably, two of these modes are strongly renormalized upon fluorine doping. These results provide significant insight into the energy and momentum dependence of the coupling of the lattice to the electron system and underline the importance of spin-phonon coupling in the superconducting iron-pnictides.