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Phase separation or not in $\mathbf{K_xFe_{2-y}Se_2}$ DESPINA LOUCA, JUNJIE YANG, University of Virginia — The coexistence of insulating and superconducting phases in the $K_xFe_{2-y}Se_2$ family of Fe-based superconductors is investigated using neutron scattering on samples grown under different conditions. In this family, three scenarios have so far been proposed regarding the superconducting phase. In the first, a superconducting minority phase with the 122 composition is separated from the insulating and majority 245 phase. Under this scenario several phase diagrams have been developed in which the superconducting phase is sandwiched between semiconducting and insulating, antiferromagnetic phases. In the second, the superconducting phases exists in an inhomogeneous structure, hence no phase separation. And in the third, a purely superconducting phase of the alkali intercalated FeSe can be made with the 122 structure that has no other phases. By probing the local structure, we previously observed that superconductivity emerges in a locally distorted Fe sublattice that accommodates two kinds of bonding environments, forming a double-well distribution that changes with the concentration of K. In addition, the Fe bond distribution changes with the annealing treatment. Implications to the coexistence of the two phases will be discussed.

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