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Structural Stability and Superconductivity in the Iron Chalcogenides[1]

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We have developed processes to grow $Fe_{1+x}Se$ single crystals and epitaxial films. X-ray diffraction measurements show that the plate side thin films of the crystal is tetragonal β-FeSe. The as grown crystals show a superconducting transition T_c at 8 K. In addition, superconducting $Fe_{1+x}(Se_{1-y}Te_y)$ thin films have also been fabricated by pulsed laser deposition on MgO. All $Fe_{1+x}(Se_{1-y}Te_y)$ films show preferred orientation and smooth surface morphology. However, a strong orientation and thickness dependence of Tc was found in $Fe_{1+x}Se$ thin films deposits at low substrate temperature. Detailed x-ray structural studies on both the single crystal and epitaxial thin films show that the existence of a low temperature structural distortion is essential for the occurrence of superconductivity.

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