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Superconducting and magnetic properties of Fe-Se-Te compounds

C.V. TOMY, G. BALAKRISHNAN, M.R. LEES, Department of Physics, University of Warwick, Coventry CV4 7AL, UK — The discovery of a new Fe based superconductor α-$FeSe_x$ with a T_c of 8 K, hot on the heels of the discovery of superconductivity in LaOFeP/As compounds, has triggered a fresh interest in the study of Fe based superconductors. Se can be replaced with Te in $FeSe_{1-x}Te_x$ and this results in an increase in T_c from 8 K for x = 0 to 15 K for x = 0.5 while compounds for x $>$ 0.8 are no longer superconducting. We report the synthesis and characterization of the compounds $FeSe_{1-x}Te_x$ covering the entire solid solution range. The superconducting transition in resistivity measurements does not show any broadening in magnetic fields up to 9 T, but shifts to lower temperatures linearly with a value $\sim$ -0.22 K/T. This results in extremely high upper critical fields (H_{c2}) of the order of 70-80 T in these compounds. The superconducting properties are also sensitive to applied pressure and exhibit a positive dT_c/dP of around 0.41 K/kbar for the x = 0.5 composition. We observe a jump in specific heat at T_c corresponding to a superconducting gap of 1.8 meV, indicating the bulk nature of superconductivity. Detailed investigations through magnetization, transport and specific heat measurements are presented. A study of the magnetic properties of the non superconducting end compound, FeTe is also presented to gain insight into the onset of superconductivity in the doped systems.

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