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Pressure and chemical tuning of charge density wave and superconductivity competition in multiband superconductors 2*H*-Pd_xTaSe_2

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We have investigated the hydrostatic pressure dependence of in-plane resistivity ρ_{ab} in the 2*H*-Pd_xTaSe_2 single crystals (intercalation ratios x = 0.03 and 0.05) up to 8 GPa with a hybrid piston cylinder cell and a cubic anvil cell. ρ_{ab} of x = 0.03 exhibits signatures of an incommensurate charge density wave (ICDW) order at 117 K and a commensurate charge density wave (CCDW) order at 91 K, and superconductivity at T_c =~2.14 K whereas for x = 0.05 [1], ρ_{ab} only shows a superconducting transition at T_c =~3.23 K. For the x = 0.03 crystal, pressure weakly suppresses the ICDW order by a rate of 2.2 K/GPa while the CCDW state is suppressed more rapidly by a rate of 7.6 K/GPa. Moreover, superconductivity is found to increase linearly from 2.14 K at 0 GPa to 2.74 K at 1.82 GPa (dT_c/dP = 0.33 K/GPa), clearly pointing out competition between the CCDW and superconductivity. In case of x = 0.05, T_c is found to increase linearly from 3.02 K at 0 GPa up to 5.01 K at 8 GPa (dT_c/dP = 0.25 K/GPa). These steep and almost linearly increasing superconducting transitions with pressure suggest that increased interlayer coupling should be effective in stabilizing superconductivity and simultaneously weakening the CCDW order in 2*H*-Pd_xTaSe_2. We also provide systematic experimental data from thermal conductivity, upper critical fields, and penetration depth that support the superconductivity in 2*H*-Pd_xTaSe_2 has the multiband character. [2]

[1] D. Bhoi, S. Khim, W. Nam, B. S. Lee, Chanhee Kim, B.-G. Jeon, B. H. Min, S. Park, Kee Hoon Kim, Scientific reports 6 (2016) 24068.

[2] Chanhee kim and Kee Hoon Kim *et al.* (unpublished)