Crystal growth and manipulation of physical properties of Weyl-Kondo semimetal $Ce_3Bi_4Pd_3$ via growth parameters

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The heavy fermion compound $Ce_3Bi_4Pd_3$ was classified as a Weyl-Kondo semimetal recently based on its non-centrosymmetric and non-symmorphic space group and the measured giant spontaneous nonlinear Hall effect [1] and a large T^3 term of the electronic specific heat in the low temperature region [1-3]. The Weyl nodes can be manipulated or even completely suppressed by stimuli such as magnetic fields [4] or subtle structural variations like defects, which implies a strong dependence of the properties on the quality of single crystals. Here we present the single crystal growth by various methods including flux (with various fluxes, Bi or Pb) and the Bridgman method. The inherent feature of the $Ce_3Bi_4Pd_3$ phase is the formation of Pd defects (vacancies) in the crystal structure, evidenced by single crystal X-ray diffraction (SCXD), X-ray powder diffraction (XPD) and supported by composition measurements by energy dispersive X-ray spectroscopy (EDX). Magnetic susceptibility and specific heat measurements show very systematic variations on crystal composition, i.e., the Pd vacancy content. Only crystals with minimal defect concentrations show strong signatures of the Weyl-Kondo semimetal. Crystal growth efforts to minimize defect concentration are described.

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