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Filled skutterudite superconductor $CaOs_4P_{12}$ prepared by high-pressure synthesis

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Abstract

In this paper, we report the transport, thermodynamic, and superconducting properties of a new filled skutterudite $CaOs_4P_{12}$ synthesized under high pressure and high temperature. The electrical resistivity of 3.4–4.8mΩcm, carrier concentration of $3.8–6.1\times10_{20}cm_{-3}$, and positive Hall coefficient suggest that $CaOs_4P_{12}$ is a semimetal with hole carriers. An anomaly due to low-energy optical modes corresponding to an Einstein temperature of 150 K was observed in the specific heat. Resistivity, dc magnetic susceptibility, and specific heat measurements indicate bulk superconductivity below 2.5 K. The specific heat anomaly at Tc, $\Delta C/\gamma Tc\approx1.4$, is in agreement with the Bardeen-Cooper-Schrieffer (BCS) value of 1.43. The electron-phonon coupling constant λ_{ep} is estimated to be 0.47. $CaOs_4P_{12}$ is classified as a BCS-type, weakly coupled type-II superconductor with an upper critical field of $H_{c2}\approx22$ kOe and Ginzburg-Landau coherence length of $\xi\approx12$ nm.