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Pressure suppression of unconventional CDW state in PrRu4P12 studied by optical conductivity

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Application of external pressure is a powerful tool to explore novel electronic states in strongly correlated materials. Optical conductivity [s(w)] technique has been an important method to probe them, since other spectroscopic methods such as photoemission and tunneling cannot be performed with a pressure cell. We have recently made high pressure s(w) studies of correlated materials including YbS [1], CeRu4Sb12 [2], SrFe2As2 [3] and PrRu4P12 [4]. Here we present results on the filled skutterudite compounds PrRu4P12 [4] and CeRu4Sb12 [2] at high pressures to 14 GPa and at low temperatures to 8 K. PrRu4P12 at ambient pressure and low temperature is insulating with a clear energy gap in s(w) [5]. This insulating state results from an unconventional CDW involving Pr sublattices with different f electron levels, unlike the usual CDW involving lattice deformation. With increasing pressure, the energy gap in s(w) is progressively filled in, and it is completely suppressed at 14 GPa and below 30 K. The pressure evolution of the unique f electron state will be discussed based on the s(w) data. CeRu4Sb12 at ambient pressure, in contrast, is a heavy fermion metal, but large increases of resistivity with pressure had been previously reported. In the measured s(w), a pronounced mid-IR peak, which is due to hybridization gap [6], shifts to higher energy with pressure [2]. Our result suggests that CeRu4Sb12 is tuned by pressure from a heavy fermion metal into a Kondo insulator.
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