Hydrostatic High-Pressure Studies to 25 GPA on the Model Superconducting Pnictide LaRu2P2

JINHYUK LIM, NEDA FOROUZANI, JAMES SCHILLING, Washington University in St. Louis, ROXANNA FOTOVAT, CHONG ZHENG, Northern Illinois Univ, ROALD HOFFMANN, Cornell Univ. — Prior to the discovery of the Fe-pnictides in 2008, the ruthenium phosphide LaRu2P2 possessed the highest value of the superconducting transition temperature, Tc ≈ 4 K, in the entire pnictide family. Recently, there has been renewed interest in this compound in an effort to better understand why the Fe-pnictides have much higher values of Tc [1]. In related phosphides superconductivity appears to only be present if the separation between the phosphor ions dp-p in neighboring Ru2P2 planes is greater than the critical value 2.8 Å, too great for a P-P covalent bond to be formed. For example, in superconducting LaRu2P2, the value of dp-p is 3.0 Å. To test these ideas directly, we have carried out hydrostatic high-pressure studies on single-crystalline LaRu2P2 in a diamond-anvil cell using He pressure medium to pressures as high as 25 GPa and temperatures as low as 1.5 K. We find that Tc initially increases under pressure, but suddenly disappears above 2.1 GPa. Since dp-p decreases under pressure, the sudden disappearance of superconductivity is likely due to the formation of a covalent P-P bond between adjacent Ru2P2 planes and a possible structural phase transition.


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