Abstract Submitted
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Origin of the Volume Collapse under Pressure in Elemental Pr and Gd[1] JINHYUK LIM, Washington University in St. Louis, TAKAHIRO MATSUOKA, Osaka University, GILBERTO FABBRIS, Argonne National Laboratory/Washington University in St. Louis, KATSUYA SHIMIZU, Osaka University, DANIEL HASKEL, Argonne National Laboratory, JAMES SCHILLING, Washington University in St. Louis — Most lanthanide metals exhibit a volume collapse at a critical pressure P_c. The primary mechanism responsible for this collapse is a matter of debate and may involve the $4f$ electrons themselves or be the result of simple $s-d$ transfer in the conduction electrons. Possible pressure-induced changes in the $4f$ electron system include: (i) valence increase, (ii) $4f$band formation, and (iii) increased $4f$-conduction electron hybridization leading to Kondo volume collapse. The results of published synchrotron spectroscopic studies at pressures near P_c (21 GPa for Pr and 59 GPa for Gd) will be critically examined. Recent high-pressure experiments on the dilute magnetic alloys Y(Pr) and Y(Gd) shed light on the appropriateness of the Kondo volume collapse model for elemental Pr and Gd. In Y(Pr) or Y(Gd) the superconductivity of the Y host is seriously weakened if Kondo pair-breaking is strong. We conclude that pressure-enhanced Kondo binding is indeed responsible for the volume collapse in Pr, whereas in Gd simple $s-d$ electron transfer is the appropriate mechanism.

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