High-Pressure Phase Transition in $Y_3Fe_5O_{12}$

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The behavior of yttrium iron garnet (YIG, $Y_3Fe_5O_{12}$) was examined up to 74 GPa and 1800 K using synchrotron x-ray diffraction in a diamond anvil cell.. At room temperature, YIG remained stable in the garnet phase until abrupt amorphization occurred at 51 GPa, consistent with earlier studies. Upon laser heating to up to 1800 K, the material transformed to a single-phase A-site disordered orthorhombic $GdFeO_3$-type perovskite of composition $(Y_{0.75}Fe_{0.25})FeO_3$. No evidence of decomposition of the sample was observed. Both the room-temperature amorphization and high-temperature transformation to the perovskite structure are consistent with the behavior of other rare earth oxide garnets. The perovskite sample was compressed from 28- 74 GPa with annealing to ~1500 K every 3-5 GPa. Between 46 and 50 GPa, an 6.8% volume discontinuity is observed without any accompanying change in the number and type of diffraction peaks. This is indicative of a high spin to low

spin transition in Fe^{3+}, likely in the octahedrally coordinated B-site of the perovskite. The properties of the inferred spin transition are generally consistent with those observed in other rare earth ferric iron perovskites at high pressures.