Pressure-induced collapse of strong ferromagnetism in YCo_5 – a pressure induced electronic topological transition

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Isomorphic lattice collapse under pressure is a rare phenomenon, usually related to a change of chemical valence. The most famous examples are samarium sulfide and cerium metal. They are cubic under ambient conditions and collapse isomorphically under pressure, with about 15% volume reduction[1,2]. In SmS the electronic transition is ascribed to a change of valence. The collapse in Ce is connected with altering contributions of the 4*f*-electrons to the chemical bonding, though details are still debated[3,4]. In contrast, the investigated YCo_5 is obviously a compound with a stable valence. We have found that an entirely new type of isomorphic transition occurs in the hexagonal metallic compound YCo_5 under hydrostatic pressure of 19GPa. Here, the volume collapse is driven by magnetic interactions and can be characterized as a first-order Lifshitz[5] or electronic topological transition. This is shown in a combined investigation using ab-initio electronic structure calculation and high-pressure x-ray diffraction. Our studies prove the existence of a bistable bonding state due to magnetoelastic interaction.

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