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On the nature of the phase transition in uranium dioxide[1] K. GOFRYK, INL, D. MAST, INL, UNLV, D. ANTONIO, K. SHRESTHA, INL, D. ANDERSSON , C. STANEK, M. JAIME, LANL — Uranium dioxide (UO_2) is by far the most studied actinide material as it is a primary fuel used in light water nuclear reactors. Its thermal and magnetic properties remain, however, a puzzle resulting from strong couplings between magnetism and lattice vibrations. UO_2 crystalizes in the face-centered-cubic fluorite structure and is a Mott-Hubbard insulator with well-localized uranium $5f$-electrons. In addition, below 30 K, a long range antiferromagnetic ordering of the electric-quadrupole of the uranium moments is observed, forming complex non-collinear 3-$\boldsymbol{k}$ magnetic structure. This transition is accompanied by Jahn-Teller distortion of oxygen atoms. It is believed that the first order nature of the transition results from the competition between the exchange interaction and the Jahn-Teller distortion. Here we present results of our extensive thermodynamic investigations on well-characterized and oriented single crystals of UO_{2+x} (x = 0, 0.033, 0.04, and 0.11). By focusing on the transition region under applied magnetic field we are able to study the interplay between different competing interactions (structural, magnetic, and electrical), its dynamics, and relationship to the oxygen content. We will discuss implications of these results.

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