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Crystal structure and absence of magnetic order in single crystalline RuO_2

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RuO_2 initially attracted interest in the field of catalysts and microelectronics, but the recent report of antiferromagnetic order occurring above room temperature and its identification
as an altermagnetic state boosted activities on this material [1,2,3].
The combination of spin splitting otherwise characteristic for ferromagnetic order with the linear magnon dispersion of an antiferromagnetic system may open the path to applications in spintronics and magnonics [4].
However, even the occurrence of magnetic order in RuO_2 was recently questioned by muon and neutron experiments as well as by DFT calculations [5-7] and it was proposed that magnetic order only occurs in the presence of vacancies [5].

We, therefore, performed polarized and unpolarized neutron diffraction experiments on RuO_2 crystals that were characterized by magnetization and electrical conductance measurements as well as by X-ray diffraction [8].
Single crystals were grown by chemical vapor transport using two different transport molecules.
In addition a powder sample was obtained by annealing a commercial compound.
The neutron experiments were performed on D9, D3 and IN12 and the crystal structure was investigated on a Bruker D8 venture diffractometer. We were not able to confirm the proposed structural distortion in our crystals down to 2K. There are no superstructure reflections [3]
breaking the symmetry of the rutile-type structure in the X-ray and long-wave length neutron experiments. Such peaks are observed for short neutron wave lengths but can be attributed to multiple diffraction. The amount of ruthenium vacancies is below a few per cent in our crystals. Polarized neutron experiments do not indicate magnetic Bragg reflections for the proposed propagation vector of $\vec{k}$=(0,0,0) [3]. Even magnetic order with a five times smaller
ordered moment than what is claimed [3] would have yielded significant intensities in our experiment. This antiferromagnetic order can be ruled out in our stoichiometric samples [8].
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