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Atomic Structure Study of the Quantum Spin-ice Pyrochlore $\mathbf{Yb_2Ti_2O_7}$ ALI MOSTAED, GEETHA BALAKRISHNAN, MARTIN LEES, RICHARD BEANLAND, Department of Physics, University of Wrwick, MICROSCOPY TEAM, SUPERCONDUCTIVITY AND MAGNETISM TEAM — The quantum spin-ice candidate $Yb_2Ti_2O_7$ (YTO) lies on the boundary between a number of competing magnetic ground states. Features in the low-temperature specific heat capacity are found to vary in sharpness and temperature depending on materials processing. It has been suggested that these changes in the magnetic ground state could be influenced by several factors, including the degree of cation stuffing, changes in oxygen occupancy and/or vacancies. In the present work, the structures of three different YTO samples, grown by the optical floating zone technique and that exhibit quite different heat capacity behaviour, have been studied by annular dark field scanning transmission microscopy (ADF-STEM). We show that the detailed intensity distribution around the visible atomic columns is sensitive to the presence of nearby atoms of low atomic number (in this case oxygen), even though they are not directly visible in the images. To the best of our knowledge, this is the first time that oxygen columns with a distance of ˜30 pm have been distinguished in ADF-STEM images. Furthermore, by comparing atomic columns with different configurations of nearby oxygen atoms, we are able to distinguish between the different YTO samples Finally, the ADF data for the crystal that exhibits no specific heat anomaly shows signs of the substitution of Yb atoms on Ti sites, supporting the view that the magnetic ground state of YTO is extremely sensitive to disorder.

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