

Much ado about nothings: the behaviour of oxygen vacancies in SrTiO₃

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There is renewed interest in the behaviour of point defects in bulk SrTiO₃ and at its extended defects due to the material's possible application in all-oxide electronics and as a memristive device. The combination of ¹⁸O/¹⁶O exchange and Secondary Ion Mass Spectrometry (SIMS) analysis constitutes a powerful tool for probing the behaviour of oxygen vacancies in oxides. In this contribution, after a brief introduction to the technique and its capabilities and limitations, I demonstrate the application of this method to investigating the behaviour of oxygen vacancies in SrTiO₃ and at its extended defects (dislocations, surfaces, hetero-interfaces). Three systems will be examined: (1) single crystal SrTiO₃ substrates; (2) low-angle grain boundaries in SrTiO₃ comprising periodic arrays of edge dislocations; and (3) thin films samples. For all three cases I will demonstrate that it is possible to predict the behaviour using thermodynamic models. In general, I will emphasize the need to combine experimental and computational approaches, and I will draw attention to current challenges and outstanding problems.