Stoichiometry Variation in Oxides and Its Impact on Ionic and Electronic Transport Properties

Joachim Maier
Max-Planck-Institut f¨ur Festkörperforschung
Heisenbergstraße 1, 70569 Stuttgart
E-mail: s.weiglein@fkf.mpg.de

Stoichiometry changes severely affect the concentration of electronic and ionic charge carriers and hence the respective transport parameters, which is of particular importance for transition metal compounds in view of the redoxvariability. The contribution addresses a variety of fundamental questions, mainly taking $SrTiO_3$ as a model material:
1. How does the oxygen content affect ionic and electronic carrier concentration in the thermodynamic equilibrium? This point is worked out for bulk and interfaces, the latter being especially relevant in nanocrystalline ceramics. It is shown that a far-reaching quantification of experimental results is possible.
2. What are the mechanisms of oxygen incorporation, and how fast does it occur? These issues are studied experimentally and theoretically, again in view of individual contributions from bulk and interfaces.
3. What is the bridge between a high temperature description for which thermodynamical equilibrium is established and the room or low temperature situation that is of typical interest for physicists? The quantification makes use of the above considerations and relies on the different mobilities of ionic and electronic carriers.

J. Maier, Physical Chemistry of Ionic Materials (Ions and Electrons in Solids), John Wiley & Sons
Ltd, Chichester, 2004.