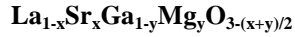


## Cation Self and Impurity Diffusion in polycrystalline



O. Schulz and M. Martin  
 Institute of Physical Chemistry I  
 Aachen University of Technology  
 Templergraben 59, 52056 Aachen, Germany

The perovskite  $\text{La}_{1-x}\text{Sr}_x\text{Ga}_{1-y}\text{Mg}_y\text{O}_{3-(x+y)/2}$  (LSGM) has been proposed as a possible candidate material for the electrolyte of solid oxide fuel cells (SOFC) [1]. The material shows a good oxygen ion conductivity at intermediate temperatures of about about 800°C [2,3] which is comparable to the conductivity of Ytria-doped Zirconia (YSZ) at 1000°C. Thus, LSGM renders possible low SOFC operating temperatures and, thereby, the avoidance of serious technical and chemical problems. Nevertheless, the study of the cation diffusion in this compound is of great practical interest to understand degradation effects like creep [4] or kinetic demixing [5].

Preparation and characterisation of single phase, dense LSGM samples and preliminary results for impurity diffusion has already been discussed in our recent publications [6,7].

Cation self-diffusion coefficients (Fig. 1) and impurity diffusion coefficients of different cations (Fig. 2) were measured by secondary ion mass spectrometry (SIMS). Cation diffusion was investigated as a function of dopant concentration and temperature between 900°C and 1400°C.

The activation energies of the diffusion coefficients change strongly with temperature. They are calculated from the local slope of the corresponding curve and plotted on the right axis of the diagrams in Fig. 1 and 2.

Independence of both, diffusion coefficients and activation energies on the expected crystallographic site of the cations was found. With respect on the perovskite structure of the LSGM system this is a rather unexpected result. Therefore possible defect models will be discussed in comparison with theoretical calculations to make suggestions on cation transport mechanisms in LSGM.

### Acknowledgments

Financial support by Deutsche Forschungsgemeinschaft (DFG) is gratefully acknowledged.

### References

- [1] M. Feng, J. B. Goodenough, K. Huang, and C. Milliken, *Journal of Power Sources* **63** (1996) 47-51.
- [2] T. Ishihara, H. Matsuda, and Y. Takita, *J. Am. Chem. Soc.* **116** (1994) 3801-3803.
- [3] M. Feng and J. B. Goodenough, *Eur. J. Solid State Inorg. Chem.* **31** (1994) 663-672.
- [4] J. Wolfenstine, P. Huang, and A. Petric, *J. Electrochem. Soc.* **147** (2000) 1668-1670.
- [5] M. Martin, *Electrochem. Soc. Proc.* **99-19** (1999), pp. 308-316.
- [6] O. Schulz and M. Martin, *Solid State Ionics* **135** (2000) 549-555.
- [7] O. Schulz and M. Martin, in *Advances in Sciences and Technology: Mass and Charge Transport in Inorganic Materials* **29** (2000) 83-89.

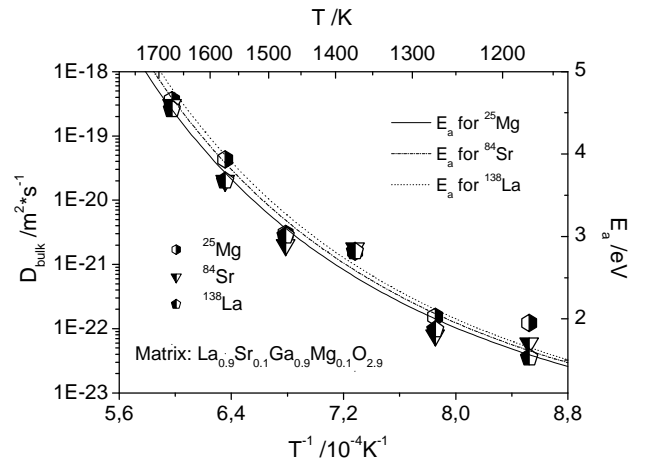


Fig. 1: Temperature dependence of the self-diffusion coefficients (left axis) and activation energies (right axis) of  $^{139}\text{La}$ ,  $^{84}\text{Sr}$  and  $^{25}\text{Mg}$  in  $\text{La}_{0.9}\text{Sr}_{0.1}\text{Ga}_{0.9}\text{Mg}_{0.1}\text{O}_{2.9}$ .

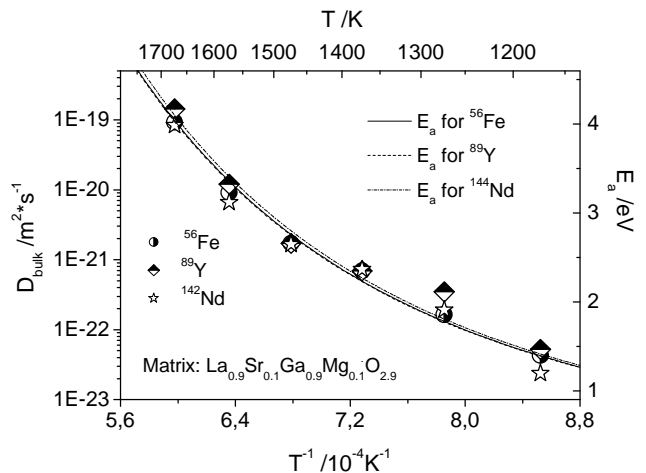


Fig. 2: Temperature dependence of the impurity diffusion coefficients (left axis) and activation energies (right axis) of  $^{144}\text{Nd}$ ,  $^{89}\text{Y}$  and  $^{56}\text{Fe}$  in  $\text{La}_{0.9}\text{Sr}_{0.1}\text{Ga}_{0.9}\text{Mg}_{0.1}\text{O}_{2.9}$ .