

In situ studies of New Energetic Materials for use in fuel cells proton Conducting

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Solid oxide fuel cells (SOFC) working around 1000 °C have drawn a growing interest in the field of energy. To increase durability and reduce the cost of these systems, one way is to lower the operating temperature. As a result, an increasing attention is paid to proton conducting cells whose operating temperatures are between 300 and 600 °C. In particular, a great effort is devoted to improving the cathode. It is suggested that the layered perovskites $\text{LnBaM}_2\text{O}_{4+d}$ (Ln=lanthanide, M = Fe, Co) and Ruddlesden-Popper (RP) materials $\text{Sr}_3\text{M}_2\text{O}_7-d$ (M = Fe, Co) which exhibit large amount of oxygen vacancies are good candidates for this application. Indeed, the RP phases which were originally proposed as SOFC cathode due to their good oxygen diffusion react with water at room temperature (RT), which suggests the possibility of proton conduction in this family of compounds. However, the high reactivity in ambient conditions leads to the decomposition and should be prevented while allowing water insertion around 300 °C.

In this project, new RP phase in which Sr is partially replaced by La, $\text{Sr}_{3-x}\text{La}_x\text{M}_2\text{O}_7-d$, is prepared to increase the stability in ambient conditions. The samples as well as the layered perovskites are heated in wet atmosphere (3-60% $\text{H}_2\text{O}/\text{N}_2$) to monitor water incorporation by thermogravimetric analysis (TGA). X-ray diffraction (XRD) is used to check the stability after heating in wet atmosphere and the structure modification related to possible water insertion into the oxygen vacancies. The RP phase $\text{La}_{1.1}\text{Sr}_{0.9}\text{MnO}_{4+d}$ which accommodates a large quantity of oxygen in its interstitial sites, as shown by neutron diffraction, is also being investigated by TGA and XRD to check whether it can accommodate $\text{H}_2\text{O}/\text{OH}^-$ in these positions.

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