Enhancing the Performance of Double Perovskite Cathode for Protonic Ceramic Fuel Cells with Mo-doping

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Abstract

Protonic ceramic fuel cells have attracted more interest than solid oxide fuel cells due to their potential to be operated at lower temperatures and therefore address the limitation for SOFC commercialization. Double perovskite materials with triple conductivity such as $PrBa_{0.5}Sr_{0.5}Co_{1.5}Fe_{0.5}O_{5+\delta}$ (PBSCF) has demonstrated outstanding performance as cathode in PCFCs [1]. Recent studies have identified high valence Molybdenum (Mo) doping as an effective strategy in increasing the surface oxygen reduction activity and reducing thermal expansion coefficient [2]. Here we enhance cathode performance by incorporating Mo into PBSCF and synthesized $PBSCFM_x$ (x = 0, 0.01, 0.03, 0.05). Results indicate that Mo-doping increases the formation of oxygen vacancies, which facilitates oxygen ion mobility. Furthermore, Mo-doping increase adsorbed oxygen which suggests more oxygen-active sites formed and the catalytic activity enhanced. Last but not least, Mo doping reduced polarization resistance of cathode, suggesting that it facilitates better charge transfer and ion mobility, leading to more efficient oxygen reduction reaction. PBSCFM01 exhibits the best performance among these three materials, which makes it promising candidate for cathode in PCFCs.

References

[1] Choi, S., Kucharczyk, C.J., Liang *et al.* Exceptional power density and stability at intermediate temperatures in protonic ceramic fuel cells. *Nat Energy*, 202–210 (2018). https://doi.org/10.1038/s41560-017-0085-9

[2] Xu, J, Cai, H, Hao, G et al. Characterization of high–valence Mo–doped PrBaCo2O5+δ cathodes for IT–SOFCs, Journal of Alloys and Compounds, 2020, https://doi.org/10.1016/j.jallcom.2020.155600.