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## Catalytic Activities of Oxychlorides for Oxygen Electrode Reactions in Alkaline Solutions

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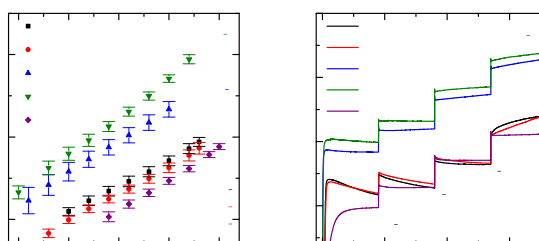
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Oxygen electrochemical reactions play an important role in high energy-density devices. In these devices, oxygen electrocatalysts should be bifunctional, *i.e.*, they should be active toward both oxygen reduction reaction (ORR) and oxygen evolution reaction (OER). Some perovskites, spinels, and pyrochlores are known to be bifunctional and cost-effective electrocatalysts.<sup>3</sup> Among them, perovskites (general formula of  $ABO_3$ ) have attracted much attention because of their ability to accommodate a wide variety of A- and B-site metal cations.

The electrocatalytic activity of the perovskite family has been improved mainly through careful selection of the configurations of cation sites. Another possible approach to enhance this activity is to partially replace the oxygen site with non-oxygen anions to form a mixed anion compound. However, so far as we know, the number of mixed-anion single perovskites,  $ABO_{3-x}X_y$ , is quite limited, where B is an active 3d transition metal toward oxygen electrochemical reactions ( $B = Mn, Fe, Co, Ni$ ) and X is a non-oxygen anion. In this study, we found that layered cobalt oxychlorides  $Sr_2CoO_3Cl$  and  $Sr_3Co_2O_5Cl_2$  exhibit high oxygen electrochemical activity compared to conventional lanthanum-based cobalt-type perovskite oxides. The enhanced oxygen electrochemical activity can be attributed to the upshifted O p-band centre relative to the Fermi level caused by the incorporation of chloride anion into oxygen sites.



**Figure.** OER properties of  $Sr_2CoO_3Cl$ ,  $Sr_3Co_2O_5Cl_2$ ,  $LaCoO_3$ ,  $LaSrCoO_4$  and BSCF. (a) Tafel plots and Tafel slopes of the catalysts calculated from average currents of positive and negative scans. (b) Galvanostep chronopotentiogram of the catalysts.

### References:

- (1) Y. Miyahara, K. Miyazaki, T. Fukutsuka, T. Abe, *Chem. Comm.* **2017**, 53, 27131–2716.