Supporting Information

The Role of the A-Site Cation on the Bifunctional Electrocatalytic Activities of Ln0.5Sr0.5CoO3-δ (Ln=La, Pr and Sm) for Rechargeable Zinc–Air Batteries

Pengzhang Li [1,*], Qing Huang [1], Wei Yang [2], Chuanjin Tian [1,*], Yumin Liu [1], Wenyan Zhao[1], Xiaojie Lu [1], Zhenbao Cao [1], Changan Wang [1,3], Zhipeng Xie [1,3]

[1]Institute of New Energy Materials and Devices, School of Materials Science and Engineering, Jingdezhen Ceramic University, Jingdezhen 333001, China
[2]School of Mechanical and Electronic Engineering, Jingdezhen Ceramic University, Jingdezhen 333403, China
[3]State Key Lab of New Ceramics and Fine Processing, School of Materials Science and Engineering, Tsinghua University, Beijing 100084, China

[*] Corresponding authors: Institute of New Energy Materials and Devices, School of Materials Science and Engineering, Jingdezhen Ceramic University, Jingdezhen 333001, PR China.
E-mail address: 15b911005@hit.edu.cn (Pengzhang Li) and tiancj11@139.com (Chuanjin Tian).

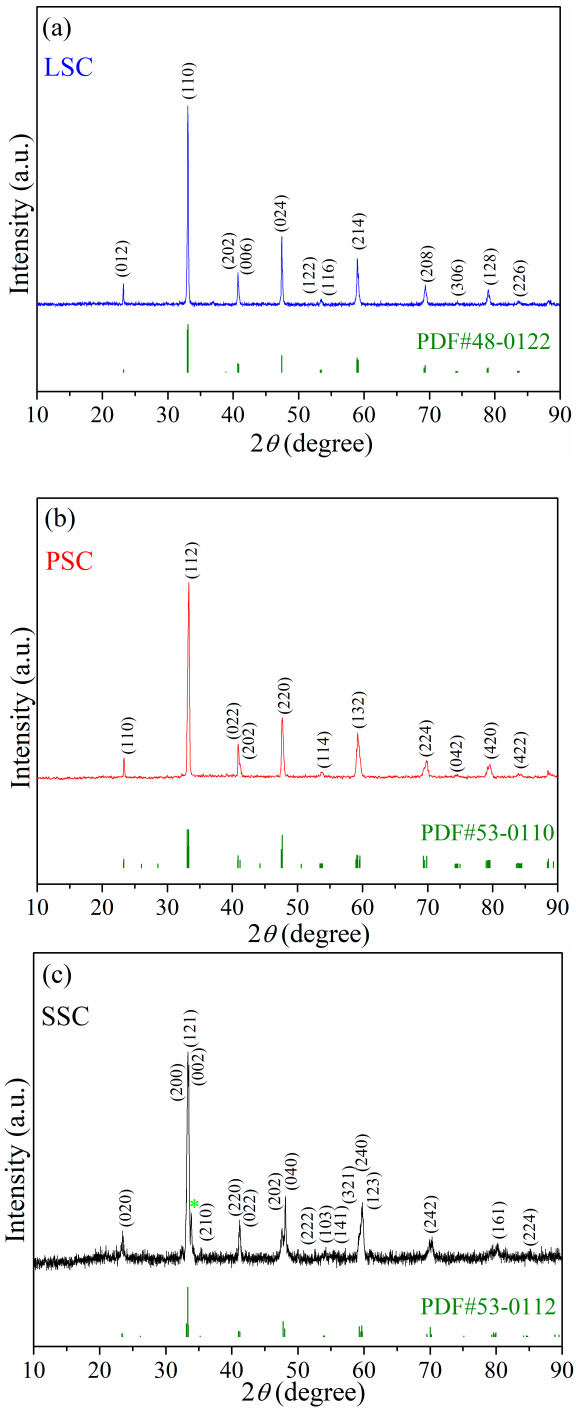

Figure S1. X-ray diffraction patterns of (**a**) LSC ($La_{0.5}Sr_{0.5}CoO_{3-\delta}$), (**b**) PSC ($Pr_{0.5}Sr_{0.5}CoO_{3-\delta}$) and (**c**) SSC ($Sm_{0.5}Sr_{0.5}CoO_{3-\delta}$) powders.

The peak labeled with an asterisk corresponds to the phase of $SmCoO_3$ (PDF#25-1071).

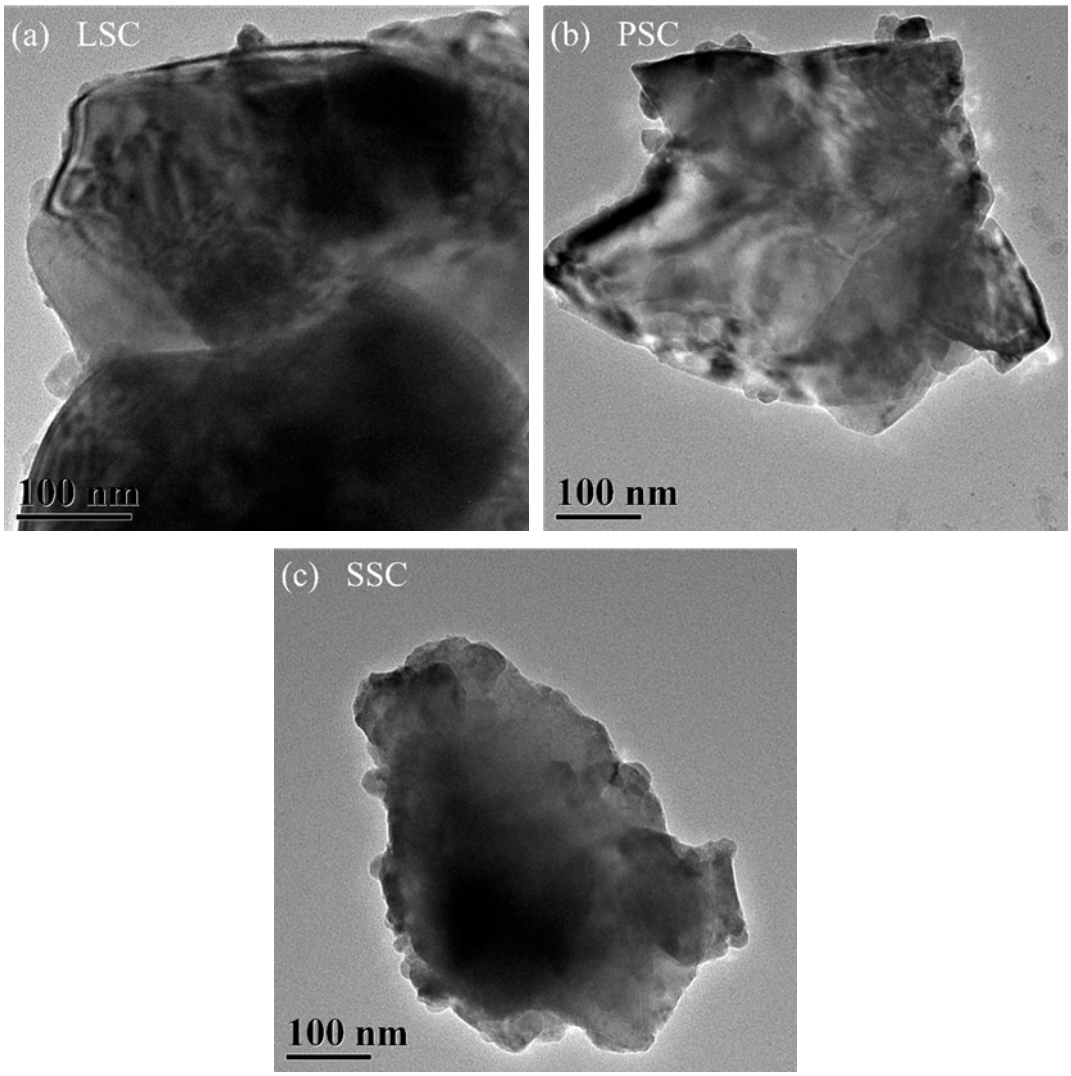

Figure S2. TEM images of (**a**) LSC ($La_{0.5}Sr_{0.5}CoO_{3-\delta}$), (**b**) PSC ($Pr_{0.5}Sr_{0.5}CoO_{3-\delta}$) and (**c**) SSC ($Sm_{0.5}Sr_{0.5}CoO_{3-\delta}$) powders.

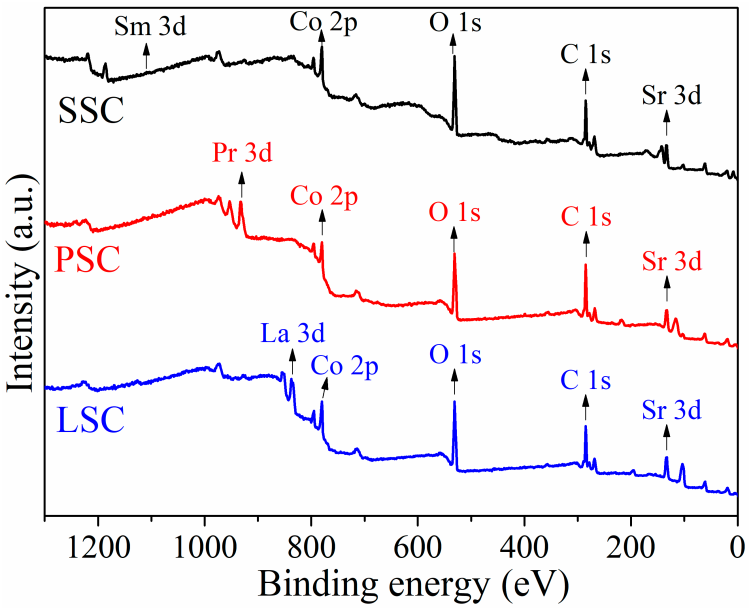

Figure S3. XPS survey spectrum of LSC ($La_{0.5}Sr_{0.5}CoO_{3-\delta}$), PSC ($Pr_{0.5}Sr_{0.5}CoO_{3-\delta}$) and SSC ($Sm_{0.5}Sr_{0.5}CoO_{3-\delta}$).

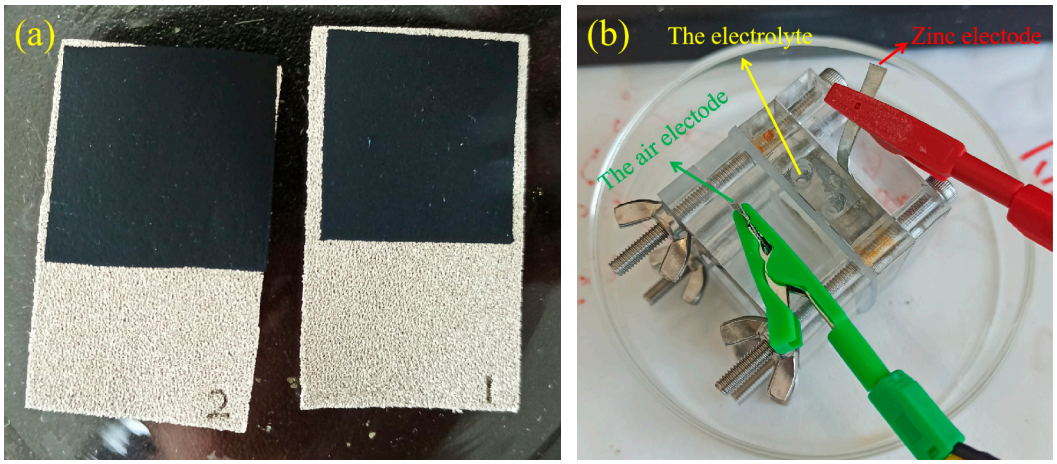

Figure S4. (**a**) Digital photos of home-made air electrodes and (**b**) the zinc-air battery assembled with the home-made air electrode.

Table S1. The Co^{3+}/Co^{2+} ratio of LSC, PSC and SSC powders in XPS test.

Sample	Peak	Valence	B.E. (eV)	Area
SSC	$2p_{3/2}$	3+	780.01	13302.15
		2+	781.17	13632.59
LSC	$2p_{3/2}$	3+	779.62	12743.58
		2+	780.81	12465.55
PSC	$2p_{3/2}$	3+	779.50	13462.21
		2+	780.69	9896.78
SSC	$2p_{1/2}$	3+	795.12	6651.07
		2+	796.46	6816.29
LSC	$2p_{1/2}$	3+	794.75	6371.79
		2+	796.27	6232.78
PSC	$2p_{1/2}$	3+	794.53	6731.10
		2+	795.76	4948.39

$La_{0.5}Sr_{0.5}CoO_{3-\delta}$ (LSC); $Sm_{0.5}Sr_{0.5}CoO_{3-\delta}$ (SSC); $Pr_{0.5}Sr_{0.5}CoO_{3-\delta}$ (PSC)

Table S2. The values of the equivalent circuit elements resulting from fitting the electrochemical impedance spectroscopy data of LSC, PSC, and SSC electrodes in the primary zinc-air batteries.

Element	LSC	SSC	PSC
R_{ohm} (Ω)	1.70	1.64	1.46
R_{int} (Ω)	0.515	0.390	0.411
R_{ct} (Ω)	1.06	1.06	0.929

$La_{0.5}Sr_{0.5}CoO_{3-\delta}$ (LSC); $Sm_{0.5}Sr_{0.5}CoO_{3-\delta}$ (SSC); $Pr_{0.5}Sr_{0.5}CoO_{3-\delta}$ (PSC)