Electronic Supplementary Information

The role of Ni substitution in manganite perovskite Li-O_2 battery

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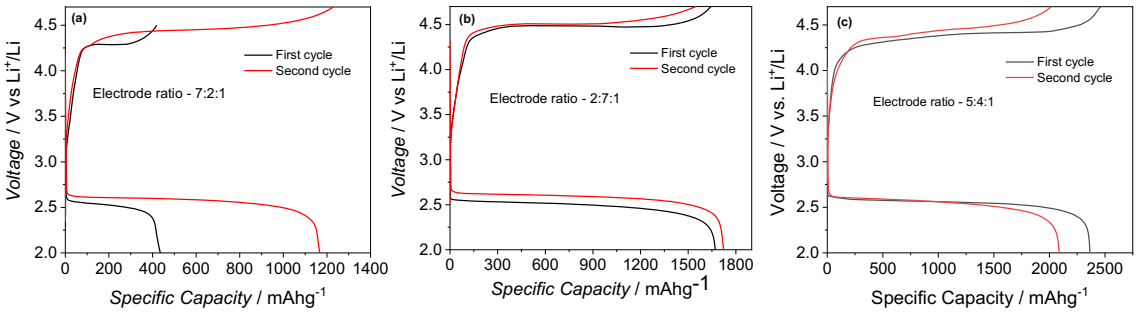

Figure S1. Discharge-charge cycles for Li-O_2 battery composed of $La_{0.7}Sr_{0.3}Mn_{0.5}Ni_{0.5}$ catalyst at different ratio of active material, acetylene black, and binding material, i.e. (a) 7:2:1, (b) 2:7:1, and (c) 5:4:1

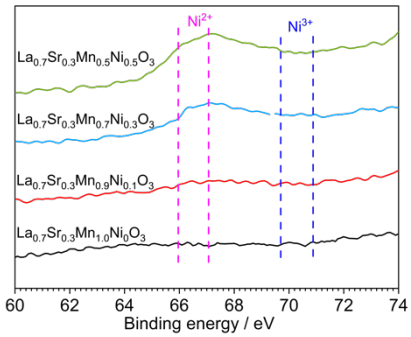

Figure S2. The Ni 3p core-level spectra for $La_{0.7}Sr_{0.3}Mn_{1-x}Ni_xO_3$ with x = 0, 0.1, 0.3, 0.5.

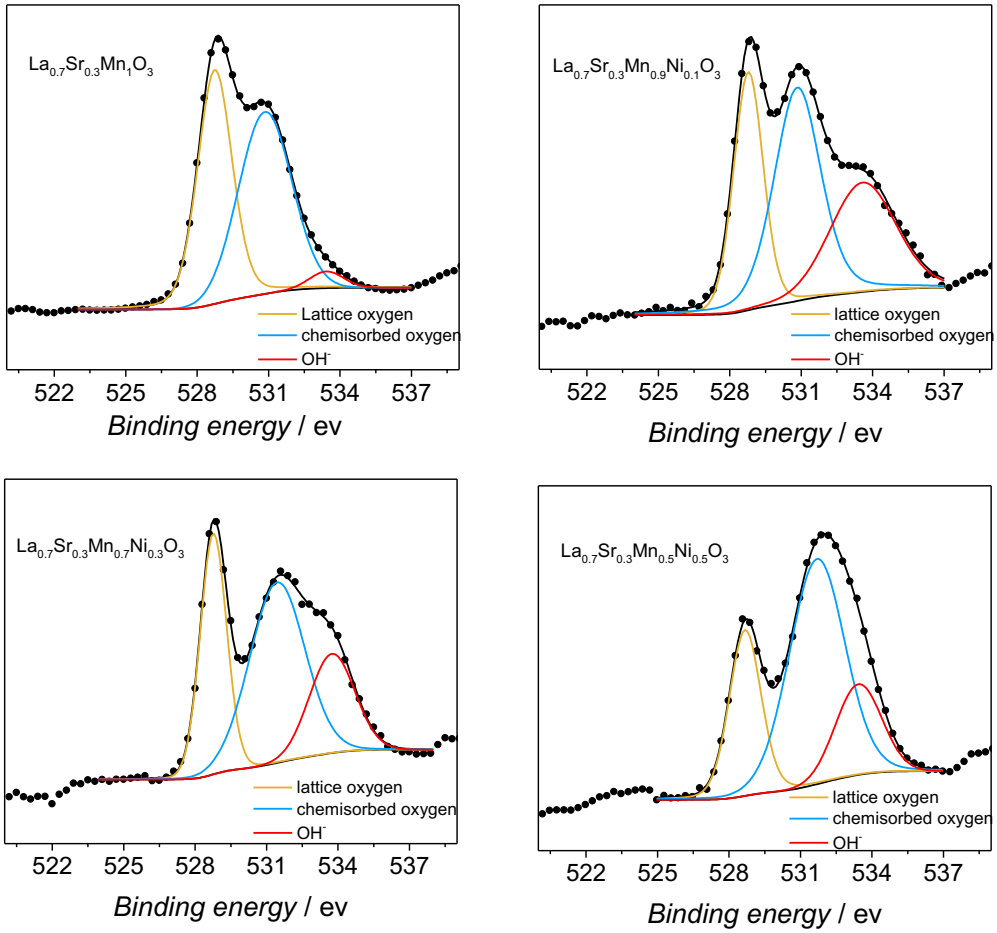

Figure S3. The O 1s core-level spectra for $La_{0.7}Sr_{0.3}Mn_{1-x}Ni_xO_3$ with x = 0, 0.1, 0.3, 0.5. The fitted O 1s spectra consist of three major peaks at approximately 529, 531, and 533 eV. These bands can be associated with lattice oxygen (O^{2-}), chemisorbed oxygen (α), and adsorbed water species (OH^-).

Table S1. Molar ratios of Mn^{3+}/Mn^{4+} on $La_{0.7}Sr_{0.3}Mn_{1-x}Ni_xO_3$(x = 0, 0.1, 0.3, 0.5), determined from XPS fitting analysis.

Catalyst	Mn^{3+}/Mn^{4+}	Average oxidation state of Mn (α)
$La_{0.7}Sr_{0.3}Mn_1Ni_0O_3$	69/31	3.3
$La_{0.7}Sr_{0.3}Mn_{0.9}Ni_{0.1}O_3$	81/19	3.1
$La_{0.7}Sr_{0.3}Mn_{0.7}Ni_{0.3}O_3$	78/22	3.2
$La_{0.7}Sr_{0.3}Mn_{0.5}Ni_{0.5}O_3$	53/47	3.5

Table S2. Comparison of specific capacity values for LSMN catalyst in aprotic Li-O_2 battery.

Catalyst	Specific Capacity	Reference
$La_{0.7}Sr_{0.3}MnO_3$	2513 $mAhg_{electrode}^{-1}$ @ 100 mAg^{-1}	Current work
$La_{0.7}Sr_{0.3}Mn_{0.9}Ni_{0.1}O_3$	3556 $mAhg_{electrode}^{-1}$ @ 100 mAg^{-1}	Current work
$La_{0.7}Sr_{0.3}Mn_{0.7}Ni_{0.3}O_3$	2499 $mAhg_{electrode}^{-1}$ @ 100 mAg^{-1}	Current work
$La_{0.7}Sr_{0.3}Mn_{0.5}Ni_{0.5}O_3$	2346 $mAhg_{electrode}^{-1}$ @ 100 mAg^{-1}	Current work
$La_{0.8}Sr_{0.2}Mn_{0.6}Ni_{0.4}O_3$	5364 $mAhg_{carbon}^{-1}$ @ 50 mAg^{-1}	[1]
$La_{0.8}Sr_{0.2}MnO_3$	4408 $mAhg_{carbon}^{-1}$ @ 50 mAg^{-1}	[1]

[1] Z. Wang *et al.*, "Nickel-Doped La0.8Sr0.2Mn1-xNixO3 Nanoparticles Containing Abundant Oxygen Vacancies as an Optimized Bifunctional Catalyst for Oxygen Cathode in Rechargeable Lithium-Air Batteries," *ACS Appl Mater Interfaces*, vol. 8, no. 10, pp. 6520–6528, Mar. 2016, doi: 10.1021/acsami.6b00296.