Electronic Supplementary Information:

Perovskite La$_{1-x}$K$_x$CoO$_{3-\delta}$ (0≤x≤0.5): A Novel Bifunctional OER/ORR electrocatalyst and Supercapacitive charge Storage electrode in Neutral Na$_2$SO$_4$ Electrolyte

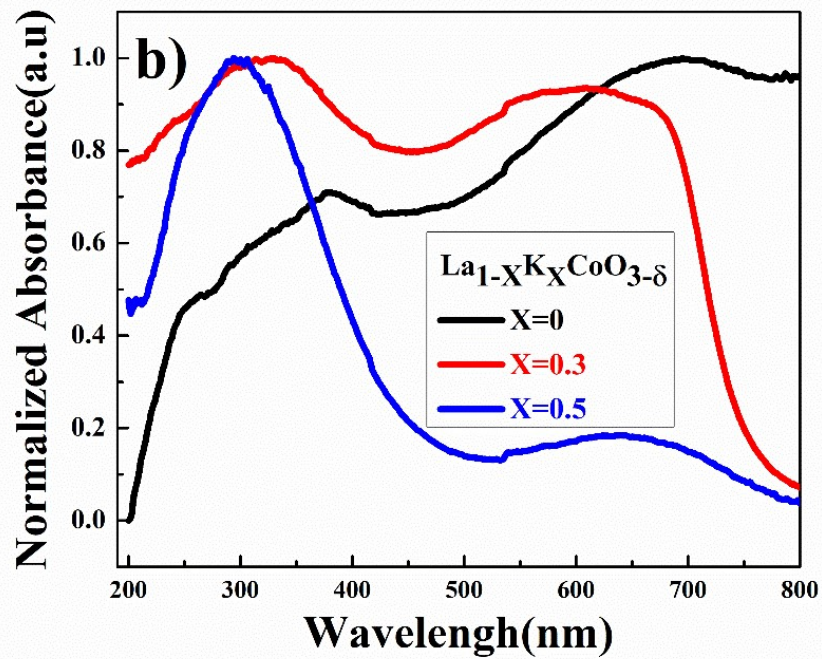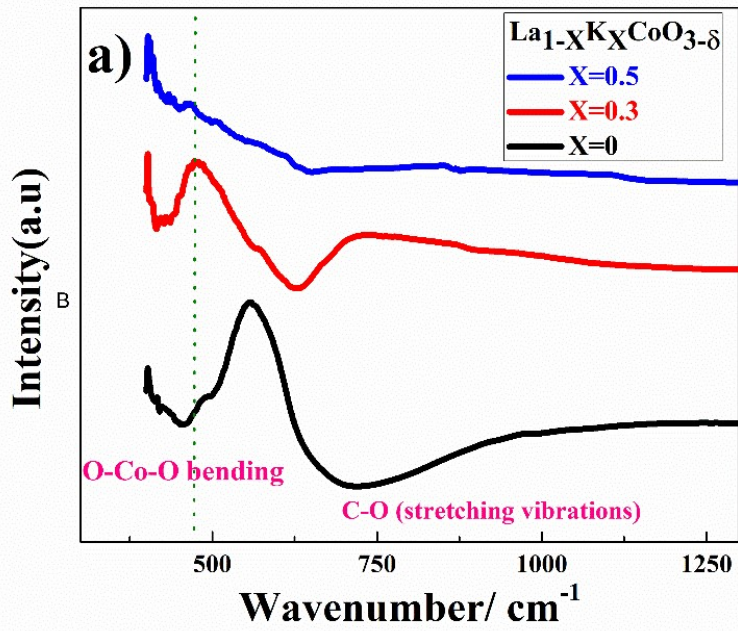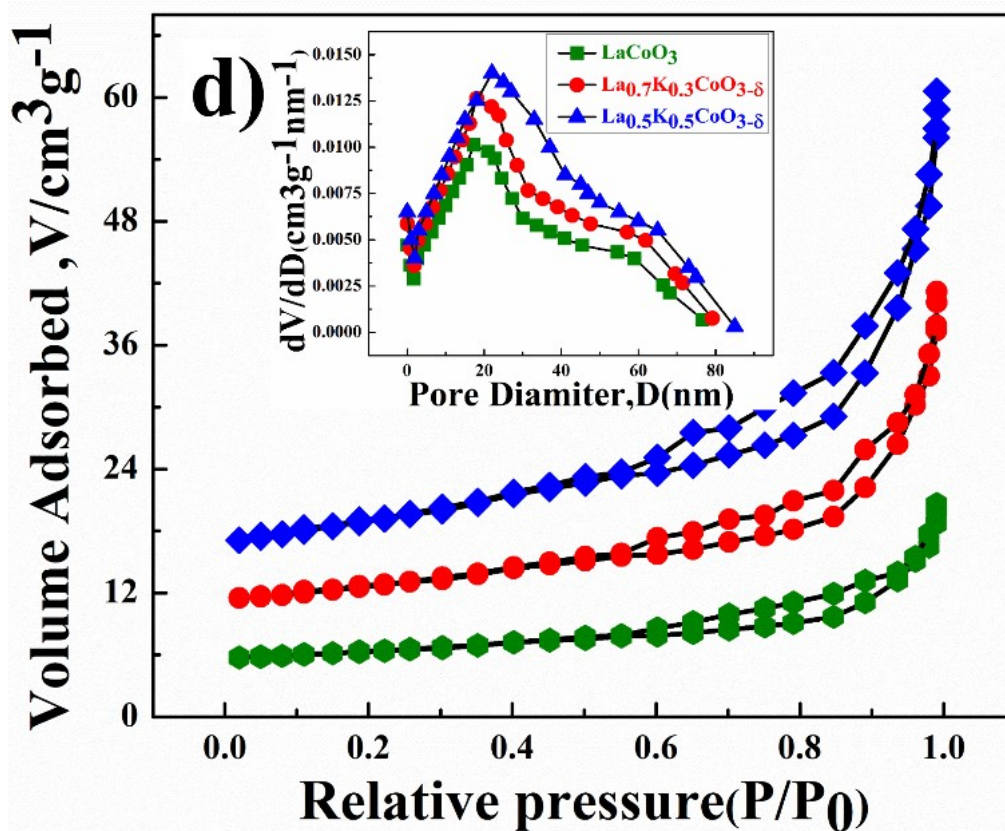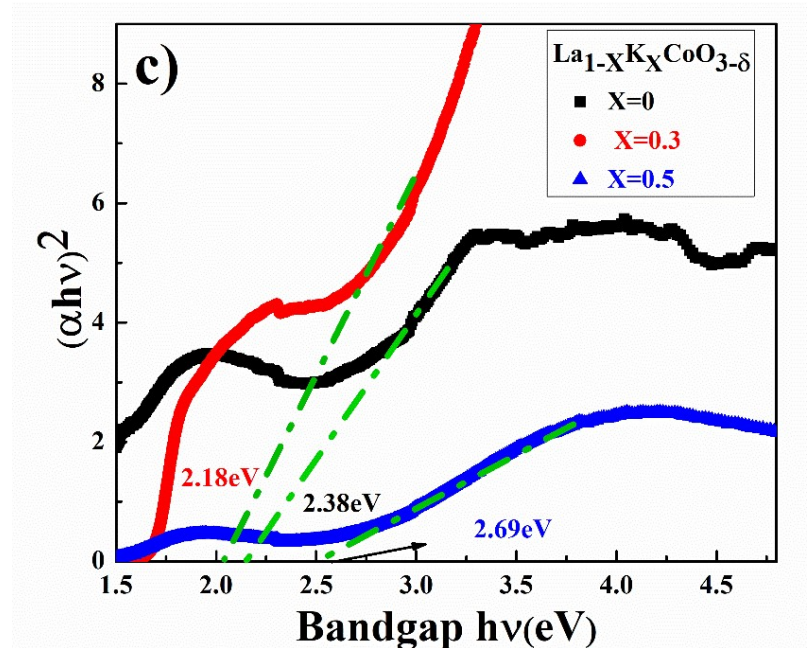Rakesh Mondal[1], Neeraj Kumar Mishra[1], Mahatim Singh[2], Asha Gupta[3,] and Preetam Singh[1]*

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a)

La$_{1-X}$K$_X$CoO$_{3-\delta}$
X=0.5
X=0.3
X=0

Intensity(a.u)

B

O-Co-O bending

C-O (stretching vibrations)

Wavenumber/ cm^{-1}

b)

Normalized Absorbance(a.u)

La$_{1-X}$K$_X$CoO$_{3-\delta}$
X=0
X=0.3
X=0.5

Wavelengh(nm)

Supporting Fig. S1. (a) FTIR, (b) UV-vis absorption spectrum, (c) Optical bandgap and (d) N_2 adsorption/desorption isotherms of $La_{1-x}K_xCoO_{3-\delta}$ (x=0, 0.3, 0.5) samples.

a) 1.7V vs. RHE

$La_{1-X}K_XCoO_{3-\delta}$
- X=0
- X=0.1
- X=0.2
- X=0.3
- X=0.4
- X=0.5

b) $La_{1-X}K_XCoO_{3-\delta}$
- X=0
- X=0.3
- X=0.5

22.3 mF/cm^2

11.2 mF/cm^2

3.7mF/cm^2

$La_{0.7}K_{0.3}CoO_{3-\delta}$
- 1m/s
- 3mV/s
- 5 mV/s
- 10 mV/s
- 15mV/s
- 20mV/s
- 25 mV/s
- 30 mV/s
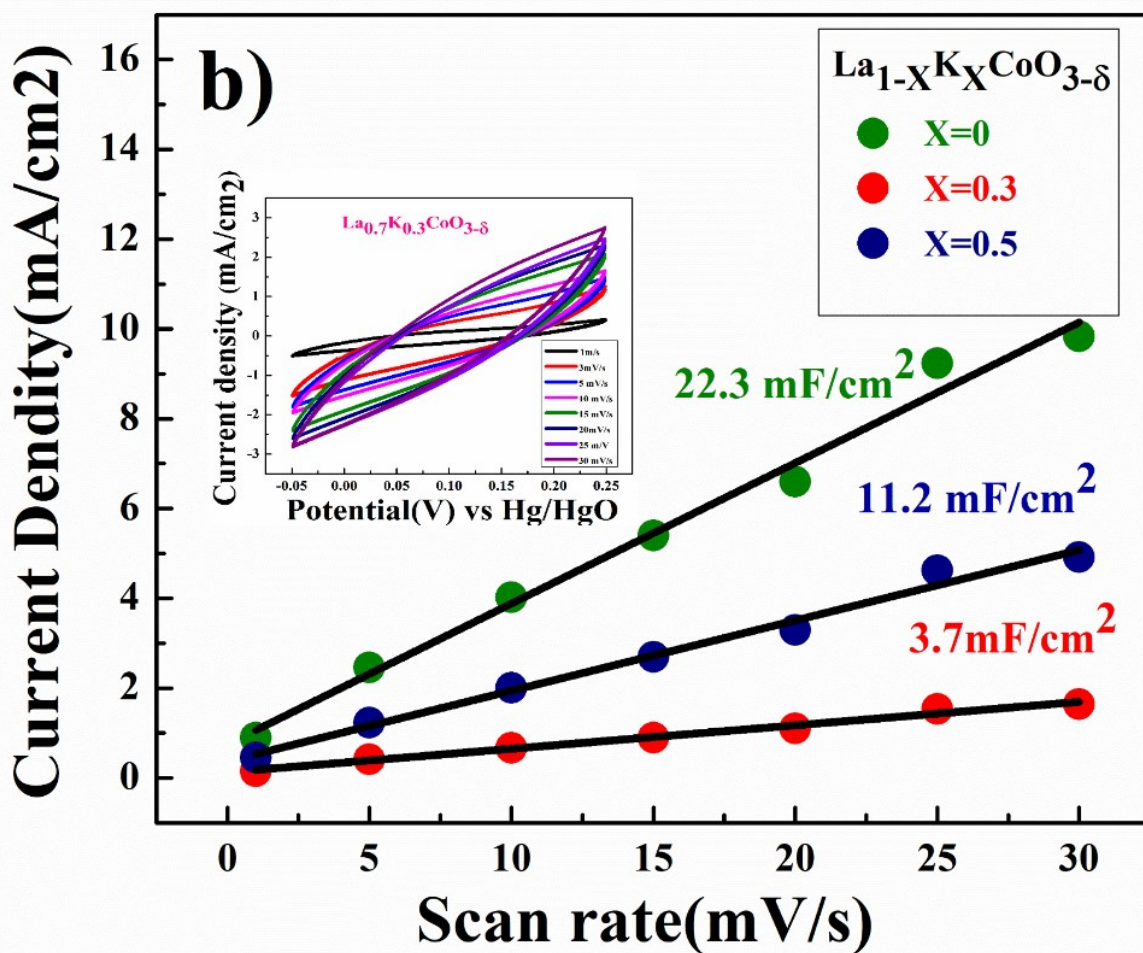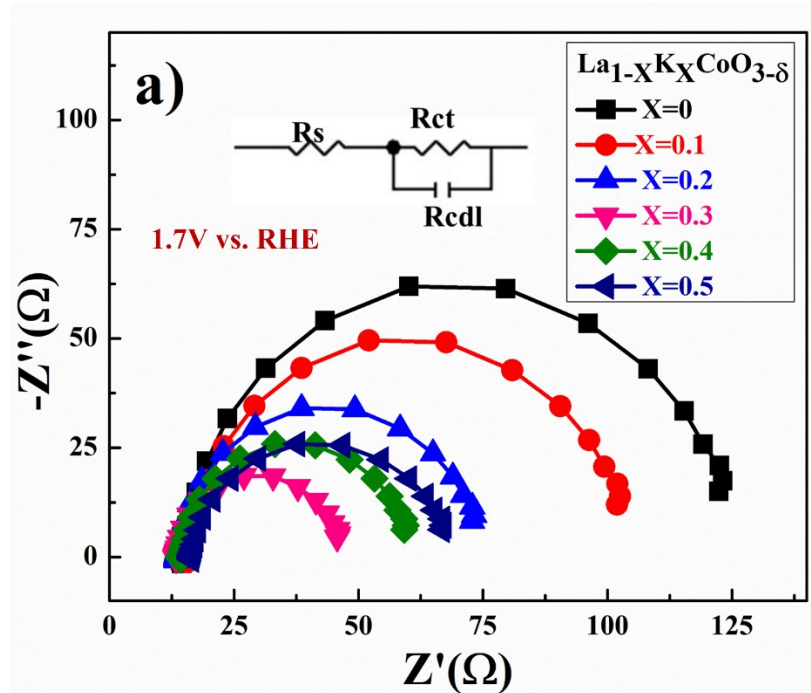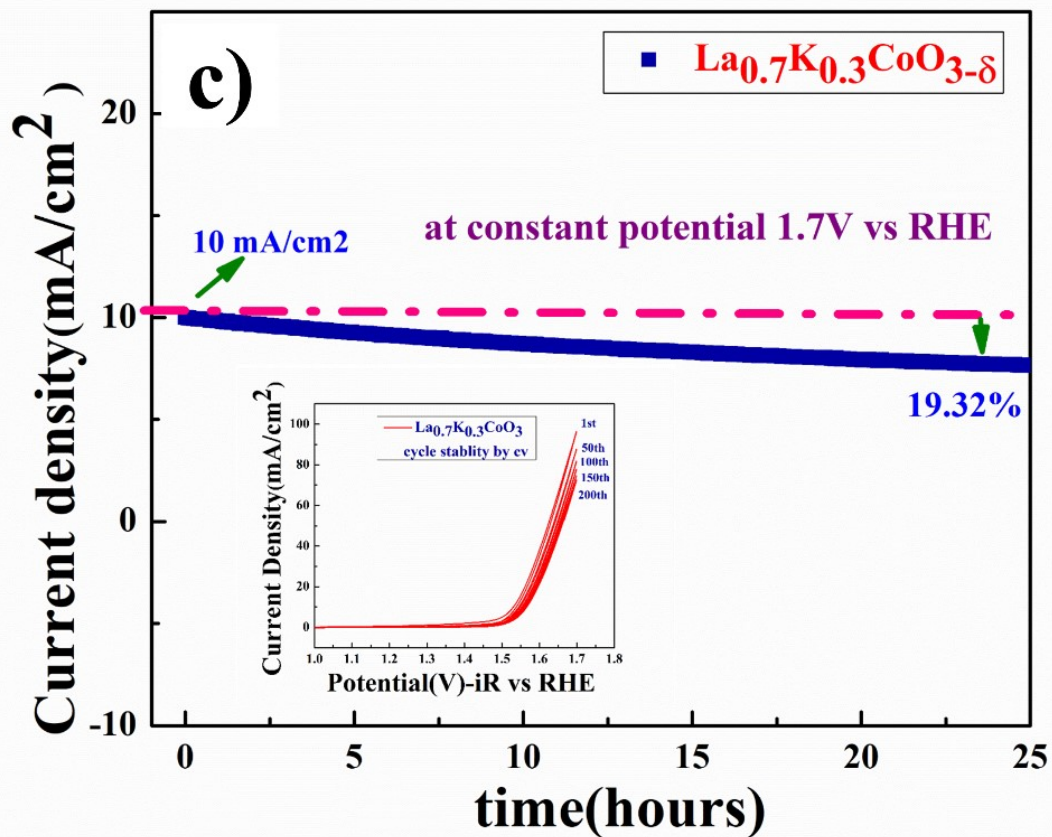
Supporting Fig. S2. (a) Electrochemical impedance (EIS) spectra for the the $La_{1-x}K_xCoO_{3-\delta}$ ($0 \leq$ x $\leq$ 0.5) samples at 1.7V vs RHE (b) Chronoamperometric responses of $La_{0.7}K_{0.3}CoO_{3-\delta}$ electrode at constant potentials at 1.7 V vs. RHE at an initial current density of 10 mA/ cm². (Insert represents the retention by CV stability). (c) represent chronoamperometric current stability of the $La_{0.7}K_{0.3}CoO_{3-\delta}$ sample.

a)

Pearson's r	0.99835	0.99141
Adj. R-Square	0.99589	0.09937
X=0	Intercept	-1.19449
	Slope	0.78252
x=0.3	Intercept	-0.60902
	Slope	0.71459
	Intercept	-0.00474
x=0.5	Slope	0.84351

$La_{1-X}K_XCoO_{3-\delta}$
- X=0
- X=0.3
- X=0.5

b)

$La_{1-X}K_XCoO_{3-\delta}$
- X=0
- X=0.3
- X=0.5

Pearso	0.9928	0.9883	0.9967
Adj. R-S	0.9923	0.9956	0.9924
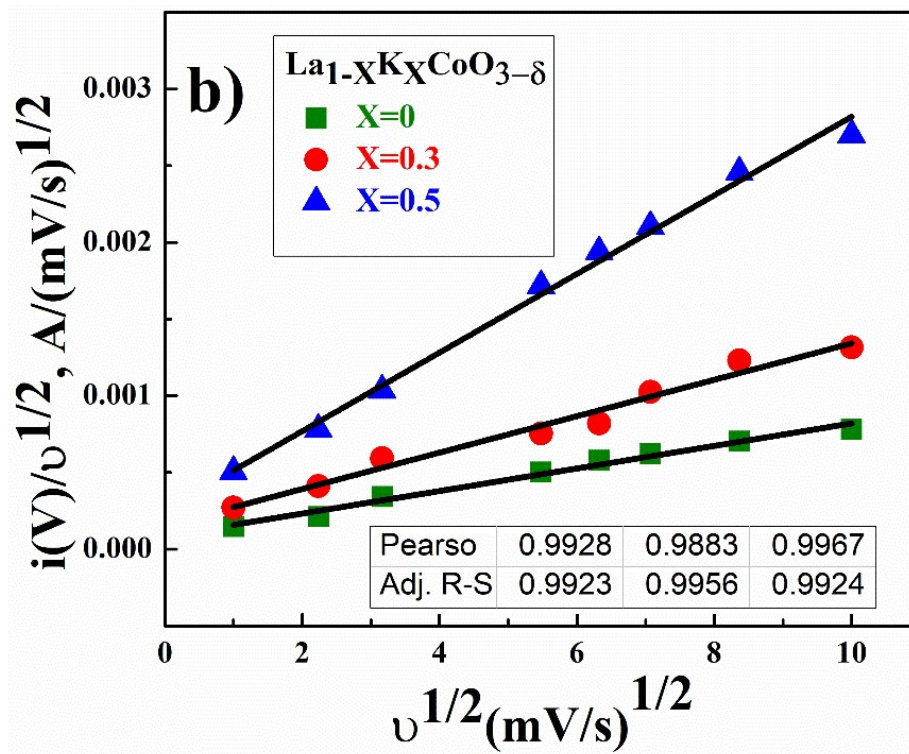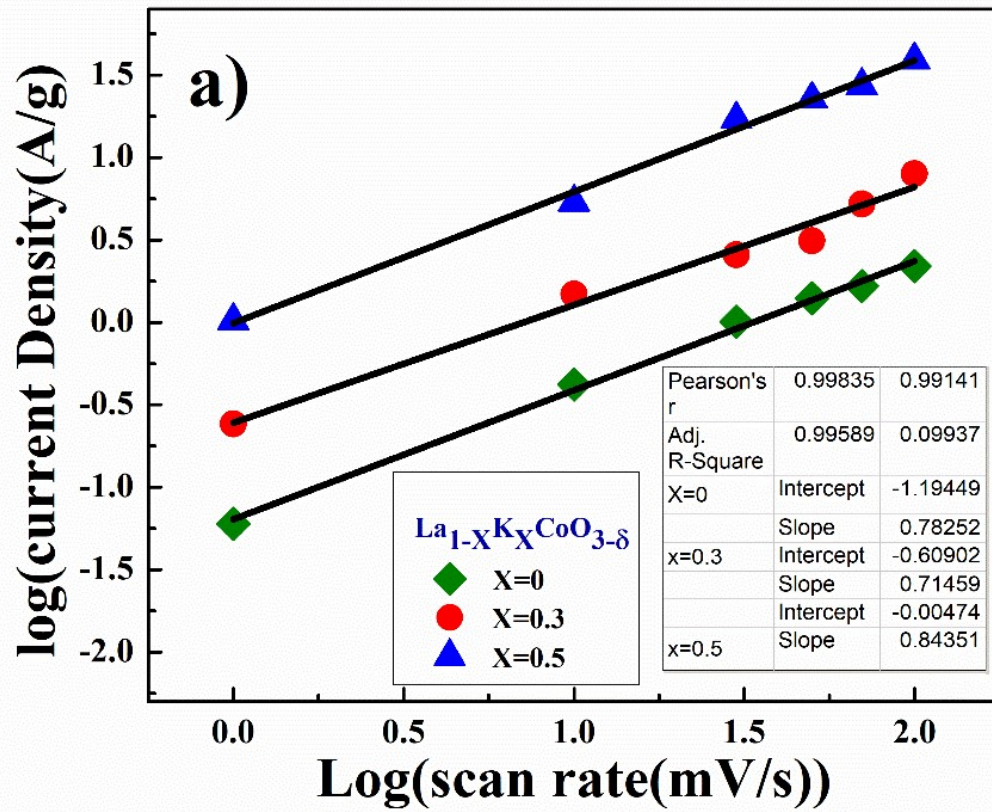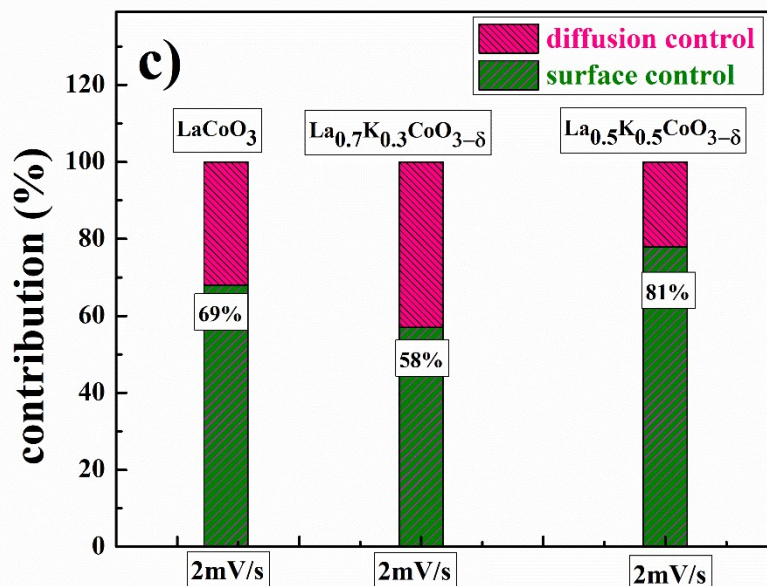
Supporting Fig. S3. (a) Plot of linear relationship between log (peak current) and log (scan rate) at two different scan rate of of $La_{1-x}K_xCoO_{3-\delta}$ (x = 0, 0.3, 0.5) samples, **(b)** Plot of power's law plot of charged and discharged state of $La_{1-x}K_xCoO_{3-\delta}$ (x = 0, 0.3, 0.5) samples. **(c)** Contribution of diffusion controlled and surface capacitance at different scan rates for $La_{1-x}K_xCoO_{3-\delta}$ (x =0, 0.3, 0.5) samples at scan rate of 2mV/s