# Abstract

It is predicted that the way in which lithium and cobalt are being used, there are chances for their deficiency in near 2040. To coverup this issue, Na is the best option for the cathode materials. In the current studies, Na and Fe-doped $LiCoO_2$ cathode material (**LixNa1-x CoyFe1-y] O2)** have been synthesized by the sol-gel method. Various characterization techniques, such as X-ray Diffraction Spectroscopy (XRD), Field-Emission Scanning Electron Microscope (FE-SEM), Fourier Transform Infrared Spectroscopy (FTIR), and Cyclic Voltammetry (CV) have been employed to identify the different properties. The structural characterization reveals that the substitution of Na for Li results in a more ordered α-NaFeO2 structure enlarges Li layer spacing, and reduces the degree of cation mixing. SEM results indicate that sphere-like particles with homogeneous distribution occur. EDX results confirm the existence of sodium in samples and mapping shows the distribution of composition. FTIR results show bending and stretching of molecular vibration. The absorption bands at low frequencies (590 $cm^{-1}$ and 530 $cm^{-1}$) have been ascribed to the vibration of asymmetric stretching of LCO. The vibrational peaks at 590$cm^{-1}$ and 530$cm^{-1}$ correspond to the stretching Co-O bonds. The galvanostatic charge/discharge results show that the electrochemical performance significantly improved. At different Scan Rate, the specific capacities of the **LixNa1-x CoyFe1-y] O2** with 10 % 20% 30% 40 % of Na and Fe doping are 174, 154,133, 95.56, and 60.09 $mAhg^{-1}$ respectively, which are superior to those of the undoped $LiCoO_2$ due to the enlargement of Li layer spacing. Results reveal that Na-doped $Li_{0.8}Na_{0.2}Co_{0.8}Fe_{0.2}]\ O_2$ is a promising cathode candidate for the next generation Lithium-ion batteries.