# Effect of Ni incorporation in KCoPO4 on the charge storage capacity of KCo1-xNixPO4 (0[?]x[?]0.5) Electrodes for the Fabrication of High-Performing Hybrid Supercapacitors

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## Abstract

To fulfill the increasing energy demands of the world through renewable energy sources requires the utilization of a highly efficient large-scale electrochemical energy storage device. A hybrid Supercapacitor (HSC) that consists of a battery-type electrode coupled with the counter capacitive electrode, while in principle offering supercapacitor-like power and cyclability values and higher energy density can be a potential device as a large-scale energy storage device to cater to the energy needs through renewable energy sources. The KCo $_{0.5}$Ni $_{0.5}$PO $_{4}$ electrode demonstrated a notably enhanced electrochemical performance attributed to the synergistic interaction of Co $^{2+}$ and Ni $^{2+}$ ions in a phosphate framework. The incorporation of redox-mediated diffusive charge storage through the incorporation of Ni $^{2+}$ on the Co $^{2+}$ site resulted in a large-scale charge storage capacity coupled with capacitive-type surface charge storage on the KCo $_{1-x}$Ni $_{x}$PO $_{4}$ electrodes. The KCo $_{0.5}$Ni $_{0.5}$PO $_{4}$ delivers 173 mAh/g (capacitances: 1038 F/g) at a current density of 0.5A/g in an aqueous 2M KOH electrolyte accompanied by cyclic stability up to 5000 cycles. HSC mode consists of Activated Carbon as the negative electrode along with KNi $_{0.5}$Co $_{0.5}$PO $_{4}$ as the positive electrode displaying high energy density and power density of 183.7 Wh/kg and 7952W/kg respectively, in 2M aqueous KOH electrolyte. The superior full performance in HSC mode makes KCo $_{0.5}$Ni $_{0.5}$PO $_{4}$ a potential positive electrode for the development of high-performing HSCs.

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