**Abstract**

Featured with superior structural stability and highest [redox potential](https://www.sciencedirect.com/topics/chemistry/redox-potential%22%20%5Co%20%22Learn%20more%20about%20Redox%20Potential%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages), the olivine LiCoPO4 parades itself as a conceit battery-type material. To deploy its foot in the field of hybrid [supercapacitors](https://www.sciencedirect.com/topics/chemistry/supercapacitors%22%20%5Co%20%22Learn%20more%20about%20Supercapacitors%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages) a series of LiCoPO4 with three contrasting morphologies were achieved. The evolution of morphology from clustered [microspheres](https://www.sciencedirect.com/topics/chemistry/microsphere) to elongated rods and multifaceted submicronic particles has an appreciative effect on the particle size and electrochemical properties. Endowed with distinct qualities such as high [crystallinity](https://www.sciencedirect.com/topics/chemistry/crystallinity%22%20%5Co%20%22Learn%20more%20about%20Crystallinity%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages), and multifaceted morphology, LiCoPO4 prepared at alkaline pH provides a superior specific capacity of 381 C g−1 (1060 F g−1) at 1 mV s−1 and a maximum discharge specific capacity of 253 C g−1 (631 F g−1) at 0.6 mA cm−2. The fabricated hybrid supercapacitor using prepared LiCoPO4 at the pH-12 condition as a battery type positive [electrode](https://www.sciencedirect.com/topics/chemistry/behavior-as-electrode) and Fe2O3 as the negative electrode provides a grander energy density of 18 Wh kg−1 at an enhanced power density of 443 W kg−1 with a sustained cyclic performance for about 5000 cycles.