

# Lithium-ion battery materials: An energy storage opportunity for Southern Africa

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**Over the past two decades, non-aqueous lithium-ion batteries have revolutionised electrical energy storage. These batteries now dominate the multi-billion dollar consumer electronics industry and the growing electric vehicle (EV) and hybrid-electric-vehicle (HEV) markets. They are also being developed for large-scale stationary energy storage.**

A major reason for this success is that aqueous battery systems such as lead-acid, nickel-cadmium and nickel-metal-hydride batteries are relatively heavy and operate at a relatively low cell voltage (<2 V), thus providing a low energy density. In contrast, non-aqueous lithium-ion (Li-ion) technology is broad-based and extremely versatile, offering systems that operate at 4 V and higher.

Furthermore, the cell voltage and energy of a Li-ion cell can be tailored by manipulation of the structure and composition of the anode and cathode materials that accommodate and release lithium ions during charge and discharge. Most cathode materials in today's Li-ion batteries are metal oxides containing lithium, cobalt, nickel, manganese and iron (Fig. 1).

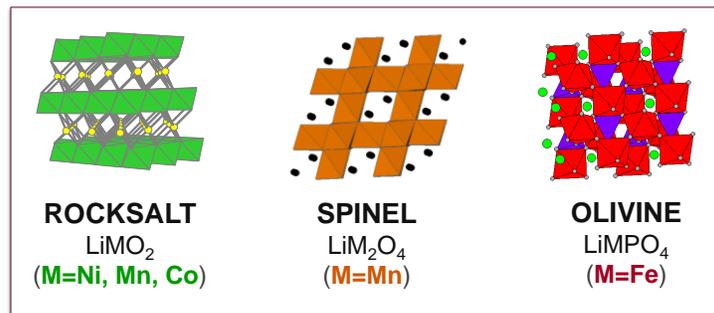


Fig. 1: The prototypical electrochemically-active components of cathode materials for 3,5-4,0 V Li-ion batteries.

Anode materials include predominantly carbon (notably graphite), lithium-titanium-oxide (spinel), and a new generation of carbon/silicon composites. Electrolytes typically contain a fluorinated lithium salt, such as  $\text{LiPF}_6$ , dissolved in an organic solvent. Southern Africa is fortunate to possess numerous mineral ores which can be beneficiated into Li-ion electrode and electrolyte products.

This presentation will summarise state-of-the-art materials technologies for Li-ion batteries, notably cathode systems, and highlight the opportunity for the Southern African subcontinent to exploit its mineral base by refining and manufacturing high-quality products for a rapidly expanding electrical energy storage industry.

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