Li-rich transition metal oxides material

KEYWORDS

- ❑ LI-ION BATTERIES
- ❑ METAL OXIDES
- ❑ POSITIVE ELECTRODES
- ❑ CATHODES
- ❑ LAYERED OXIDES

AREA

- ❑ ENERGY & ENVIRONMENT

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Patent for invention.

Co-Ownership
Sapienza 25%, Fondazione Istituto Italiano di Tecnologia 52,5%, Università degli Studi di Genova 22,5%

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Industrial & Commercial Reference
Industrial production of advanced materials for batteries.

Time to Market
TRL4 – ttm 24-36 MONTHS.

Availability
Cession, Licensing, Research, Development, Experimentation and Collaboration.

Fig. 1 Lithium-rich transition metal mixed oxide.

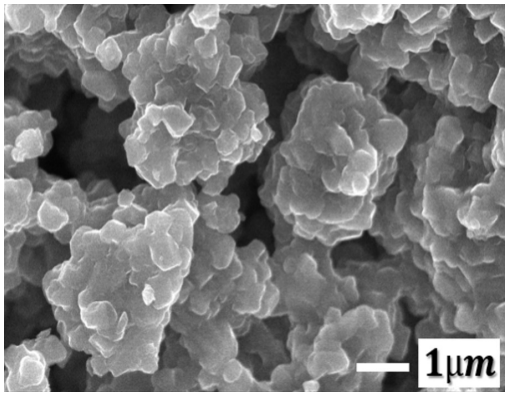

Fig. 2 Scanning electron microscopy of the lithium-rich material.

Abstract
Object of the invention is the development of a new over-lithiated layered metal (OLiLM) oxide material with a lower content of cobalt compared to the actual commercial cathode materials and the addition of the cheaper and less toxic Al. These new family of OLiLM shows a layered structure and consists of sub-micron particles of spherical shape. The materials proposed can exchange approximately 200 mAh/g in lithium cell for 200 cycles using a current density of ≈40 mA/g (C/10) in a potential range of 2-4.8V. The discharge capacity is about 120 mAh/g at 1C (754 mA/g) with a capacity retention of 70 % after 500 cycles.

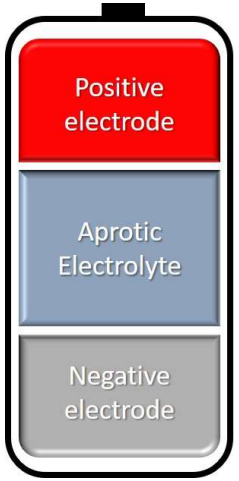

Fig. 3 General scheme of an aprotic battery.

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Technical Description

Materials constituted by transition metal/non-transition metal oxides rich in lithium to be used as active component in positive electrodes for aprotic lithium-ion batteries. These materials show a partially disordered crystal structure constituted by the stacking of bidimensional layers and a sub-micrometric controlled morphology. The abovementioned materials, obtained by means of a sol-gel aqueous synthesis, show a smaller cobalt content in respect to existing lithium-rich materials used in lithium batteries. At the same time the materials can supply excellent battery performance in terms of specific capacity, cycling stability and rate capability.degradation in biological fluids.

Fig. 4 composite electrodes constituted by lithium rich layered oxides.

Technologies & Advantages

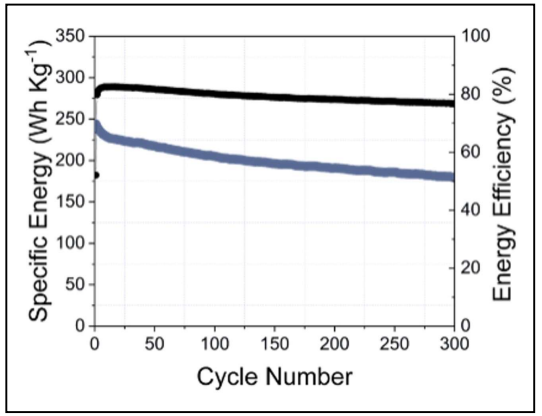
Lithium-rich partially disordered material with layered structures claimed in this invention show, in respect to the commercial state-of-the art of positive electrodes for Li-ion batteries, a number of positive and competitive properties: (1) a smaller cobalt content (an expensive metal, toxic and included in the “critical raw materials” list from UE https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0474); (2) excellent performance in batteries in terms of specific capacity, cycling stability and rate-capability (200 mAh/g after 200 cycles at i=40 mA/g (C/10) in the range 2-4.8V; 120 mAh/g at 1C (754 mA/g) with a capacity retention of 70% at cycle 500); (3) an aqueous sol-gel synthesis that avoids the use of solvents (green chemistry route)

Fig. 5 Aqueous reagents for the materials synthesis.

Applications

Materials claimed in this invention can be adopted as electroactive components in positive electrode for next generation aprotic lithium-ion and lithium metal batteries. These lithium partially disordered materials with layered structures can disclose excellent performance in terms of specific capacity, capacity retention and rate capability: the specific application range of the objects of this invention are composite positive electrodes used in electrochemical cells for battery packs for electric transportation and stationary energy storage (both industrial and domestic).

Fig. 6 example of the energetic performance of the lithium-rich material in lithium-ion cell vs. graphite.



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