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Layered oxides  
containing cobalt and  
nickel are the most  
studied materials for  
lithium-ion batteries.  
Dudney and B.J.  
Neudecker. State-of-  
the-art cathode  
materials include  
lithium-metal oxides  
[such as  $\text{LiCoO}_2$ ,  
 $\text{LiMn}_2\text{O}_4$ , and  
 $\text{Li}(\text{Ni}_x\text{Mn}_y\text{Co}_z)\text{O}_2$ ],

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vanadium oxides,  
olivines (such as  
 $\text{LiFePO}_4$ ), and  
rechargeable lithium  
oxides.

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The charts below show recent pricing trends in two of the raw materials used for certain components of LIBs: Lithium and cobalt. Two forms of lithium — lithium carbonate and lithium hydroxide — are needed for the cathode (negatively charged electrode) of an LIB.

## **Raw Materials Used To Make Lithium-Ion**

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In lithium-ion batteries, lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge. The process is reversed when charging. Li ion batteries typically use lithium as the material at the positive electrode, and graphite at the negative electrode.

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State-of-the-art  
cathode materials  
include lithium-metal  
oxides [such as  $\text{LiCoO}_2$ ,  $\text{LiMn}_2\text{O}_4$ , and  $\text{Li}(\text{Ni}_x\text{Mn}_y\text{Co}_z)\text{O}_2$  ],  
vanadium oxides,  
olivines (such as  
 $\text{LiFePO}_4$  ), and  
rechargeable lithium  
oxides. 11,12 Layered  
oxides containing  
cobalt and nickel are

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the most studied  
materials for lithium-  
ion batteries.

## **Materials and Processing for lithium-ion Batteries**

Lithium ion batteries (LIBs) have emerged as the battery of choice for rapidly growing markets in electric vehicles (Evs) and grid electricity storage. Challenges in the supply chain of raw materials: •Demand for

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lithium, graphite, cobalt, and nickel could outstrip supply of virgin material

- Concentration of mining in only a few countries

## **Supply-Chain Green Analysis of Lithium- Ion Battery Material and ...**

In a Li-ion battery,  $\text{Li}^+$  is the guest ion and the host network compounds are metal chalcogenides,

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transition metal oxides,  
and polyanion  
compounds. These  
intercalation  
compounds can be  
divided into several  
crystal structures, such  
as layered, spinel,  
olivine, and tavorite (Fig. 4 ).

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(abbreviated as LIB) is a type of rechargeable battery. Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications. A prototype Li-ion battery was developed by Akira Yoshino in 1985, based on earlier research by John Goodenough, M.

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## **Lithium-ion battery - Wikipedia**

The anode (or negative electrode) in Lithium-ion battery is typically made up of Graphite, coated on Copper Foil. Graphite is a crystalline solid with a black/grey color and a metallic sheen. Due to its electronic structure, it is highly conductive and can reach 25,000

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S/cm<sup>2</sup> in the plane of a  
single-crystal.

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Anode materials make up 10% to 18% costs of materials for lithium-ion battery. In 2018, China's shipment of anode materials was 192 kilotons with an upsurge of 31.51% on an annualized basis, and is...

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## **Global and China Lithium-ion Battery Anode Material ...**

Lithium-ion batteries have a tendency to overheat. Researchers at Texas A&M

University working on technology that prevent lithium batteries from heating and failing have designed anodes (electrical...

**Fully Charged:**

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**Breakthroughs in  
Lithium-ion Battery  
Materials**

BASF's broad battery materials portfolio includes advanced cathode active materials for lithium-ion batteries such as Nickel Cobalt Aluminum (NCA) oxide and Nickel Cobalt Manganese (NCM) oxide, which play a key role in determining battery performance, energy density, service

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life and safety.

## **Battery Materials - BASF Catalysts**

Li-ion batteries can use a number of different materials as electrodes. The most common combination is that of lithium cobalt oxide (cathode) and graphite (anode), which is most commonly found in portable electronic devices such as cellphones and laptops.

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## **Lithium-Ion Battery - Clean Energy Institute**

Minerals such as lithium-containing spodumene and pegmatites, nickel, cobalt, manganese, vanadium, natural graphite, copper and aluminium are all found in significant quantities. In mid-2018, Australia overtook Chile as the world's largest lithium

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producing nation, with production increasing 34 % in one year alone.

## **Lithium-Ion Battery Chemistries - Advanced Auto Bat Asia**

As the energy density of conventional Li-ion batteries based on intercalation-type active materials, such as such as lithium nickel cobalt manganese oxide (NCM) or lithium nickel



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cobalt aluminum oxide (NCA) cathodes and carbonaceous anodes, approaches their theoretical limits, we have little choice but to move to so-called conversion-type electrodes, such as lithium sulfide ( $\text{Li}_2\text{S}$ ) or lithium fluoride/iron (Fe)-based cathodes and either Li or silicon (Si)-based anodes in order to double ...

## **Conversion-Type**

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Lithium ion batteries are manufactured in sets of electrodes and then assembled in cells. Active material is mixed with polymer binders, conductive additives, and solvents to form a slurry that is then coated on a current collector foil and dried to remove the solvent and create a porous electrode

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coating.

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Titanate Oxide, Lithium  
Manganese Oxide,

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(Lithium Nickel Cobalt  
Aluminum Oxide), By  
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