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Research in lithium-ion batteries has produced many proposed refinements of lithium-ion batteries. Areas of research interest have focused on improving energy density, safety, rate capability, cycle durability, flexibility, and reducing cost.

Artificial intelligence (AI) and machine learning (ML) is becoming popular in many fields including using it for lithium-ion battery research. These methods have been used in all aspects of battery research including materials, manufacturing, characterization, and prognosis/diagnosis of batteries.[1]

Lithium-ion battery negative electrodes are most commonly made of graphite. Graphite anodes are limited to a theoretical capacity of 372 mAh/g for their fully lithiated state.[4] At this time, significant other types of lithium-ion battery anode materials have been proposed and evaluated as alternatives to graphite, especially in cases where niche applications require novel approaches.

Research to inhibit dendrite formation has been an active area. Doron Aurbach and co-workers at Bar-Ilan University have extensively studied the role of solvent and salt in the formation of films on the lithium surface. Notable observations were the addition of LiNO3, dioxolane, and hexafluoroarsenate salts. They appeared to create films that inhibit dendrite formation while incorporating reduced Li3As as a lithium-ion conductive component.[18][19]

In 2021, researchers announced the use of thin (20 micron) lithium metal strips. They were able to achieve energy density of 350 Wh/kg over 600 charge/discharge cycles.[20]

Various forms of carbon are used in lithium-ion battery cell configurations. Besides graphite poorly or non-electrochemically active types of carbon are used in cells such as CNTs, carbon black, graphene, graphene oxides, or MWCNTs.

Recent work includes efforts in 2014 by researchers at Northwestern University who found that metallic single-walled carbon nanotubes (SWCNTs) accommodate lithium much more efficiently than their semiconducting counterparts. If made denser, semiconducting SWCNT films take up lithium at levels comparable to metallic SWCNTs.[21]

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