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Lithium-ion rechargeable batteries (LIBs) are widely used from portable communications to power infrastructure and electric vehicles. They contain critical materials that need to be reclaimed for recycling and manufacturing when these applications reach end-of-life (EOL). According to the Allied Market Research, the LIB recycling market will be \$66.6 B by the end of the decade with a 19.6% compound annual growth rate. About half of that market is to address the logistical costs of managing the hazardous characteristic flammability of LIBs. EOL LIBs are a logistical liability. Even when “dead” they have significant safety risks. If exposed to thermal or physical insults, they can catch fire. Damaged batteries can unpredictably catch fire, and damage can be not so obvious to even a skilled observer. This makes aggregation and distribution extremely challenging as one bad cell catching fire will propagate to the neighboring ones. According to Wastedive, there were 390 waste and recycling facility fires in the U.S. and Canada in 2022, the highest reported to that date. Typical countermeasures for fires include limiting the amount of EOL material in a shipment, packaging with heat absorbent materials, and storage in strong boxes. Packaging and skilled handling translate to high cost for EOL logistics. Current strategies do not address the fundamentals of the fire triangle, but only contain the potential fire.

To address the problem OnTo workers developed innovative methods to eliminate the root cause of flammability in lithium-ion. Fire requires a fire triangle with fuel, ignition, and oxygen; batteries have all three legs manufactured together. To make them safe, the invention uses low-cost non-toxic materials to extensively passivate lithium and remove and neutralize flammable components. Removal of two legs of the fire triangle eliminates the capability to catch fire. The resulting non-flammability of the neutralized material has been verified with testing by Sandia National Laboratories and non-hazardous characteristics have been verified by EPA certified laboratories. The neutralized product material does not require costly packaging and management. The overall savings can be perhaps 30% (through low cost transportation and insurability). EOL safety and low-cost enabled through OnTo’s battery neutralization technology helps to improve the environmental and economic sustainability of LIBs, making them more affordable.

The battery neutralization development was supported by the US Department of Energy and US Defense Logistics Agency. The US patent office approved the invention by Steve Sloop and Lauren Crandon for “Battery Deactivation”, US #12,021,202 on June 25, 2024.



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