Quantifying the Evolution of Gas from Li-Ion Battery Materials

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There is a growing problem of critical failure in many commercially manufactured Li-ion batteries today due to gas evolution. To determine a safer composition of Li-ion batteries for public consumption, this project set out to understand the reaction between LiNiMnCoO2-based electrodes and carbonate-based electrolytes, specifically ethylene carbonate (EC) and Dimethyl carbonate (DMC). NMC electrodes of varying composition were cut into coin cells and placed with varying volumes of 3:7 EC/DMC electrolyte mixtures in a pouch, where the Archimedes Buoyancy method was used to determine the amount of gas generated after the pouch's exposure to either room temperature or heat after a period of time ranging from hours to days. The ethylene carbonate reacted more strongly than the DMC with the NMC electrodes resulting in significant gas production in contact with some of the cathodes investigated. This is significant because the test demonstrates that the EC ring structure is more reactive and unstable than the linear structure of the DMC, pointing towards the creation of potentially catastrophic reactions in Li-ion batteries. While more tests are being done to determine the rate of the reaction as well as composition of the gases being generated, this research will ultimately lead to a better understanding for the production of safer and more efficient batteries for the commercial market.