The path to CO2 negative battery production: Sustainable carbon materials for energy storage

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The megatrend of electrification is one of the main tools to reduce global carbon emissions. Efficient and effective electrification requires significant amounts of energy storage devices such as lithium-ion and sodium-ion batteries, which in turn require copious amounts of materials such as lithium, sodium, various transition metals and – for almost all battery chemistries – carbon materials such as graphite, carbon nanotubes, hard carbon and carbon black.

Today the carbon footprint of lithium-ion batteries is up to 196 kg of CO2 equivalents emitted for every kWh of li-ion battery produced. Over 50% of this footprint relates to the raw materials alone, with >5% attributed to graphite (in the case of LFP based batteries).(1)

Reducing the amount of carbon emissions in raw material production thus offers a large impact in reducing carbon emissions for energy storage, further reducing the overall emissions on the path to a global zero carbon emission scenario.

The average Li-ion battery requires ca. 1 kg of carbon materials per kWh stored. Utilizing carbon from CO_2 in electrochemical processes to synthesize carbon materials offers the possibility to both immobilize CO_2 as well as to provide a valuable input material to the electrification value chain.

UP Catalyst has developed a method to synthesize carbon materials from CO_2 using only CO_2 and electricity as active ingredients. This electrochemical method can be used to synthesize MWCNTs and graphitic materials, which in turn can be used as conductive additives or active materials in Li-ion (or Na-ion) batteries. At scale, the method can utilize CO_2 streams from hard-to-abate industries such as concrete, steel, glass and chemical industry, preventing CO_2 to reach the atmosphere and instead immobilizing the emission within the carbon material.

Within this presentation, we present the innovation and methods used as well as some insight into the use of the prepared materials within energy storage devices, also emphazising the global potential impact of these materials on the carbon emissions of the energy storage industry.

References

(1) Jorge A Llamas-Orozco, Fanran Meng, Gavin S Walker, Amir F N Abdul-Manan, Heather L MacLean, I Daniel Posen, Jon McKechnie, Estimating the environmental impacts of global lithium-ion battery supply chain: A temporal, geographical, and technological perspective, PNAS Nexus, Volume 2, Issue 11, November 2023, pgad361, https://doi.org/10.1093/pnasnexus/pgad361.