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Talk title: Critical Raw materials from CO_2: Sustainable synthesis of Nanotubes and Graphite

Carbon materials such as carbon nanotubes (CNTs) and Graphite are crucial components in multiple technologies relevant to carbon emission reduction, such as Lithium-ion batteries, strength-improved polymers and different composite materials. However, both Graphite and CNTs are currently obtained by methods that themselves have large carbon footprints, reducing the efficacy of the emission reduction intended when applying these materials. While Graphite is either mined or produced synthetically from petroleum coke, CNTs are made from chemical vapor deposition (CVD) methods. Synthetic Graphite production methods result in c. 14 kg CO_2-eq/kg of Graphite, while CNTs from CVD result in over 200 CO2-eq/kg of CNTs in emissions.

Carbon materials, however, can also be made from CO_2 directly. One of the most promising methods in this regard is the molten salt carbon capture electrolysis transformation (MSCC-ET). In this method, CO_2 from emission streams is pumped into a molten salt bath, where it is electrolyzed into carbon and oxygen. Depending on the carefully tailored reaction conditions, CNTs or Graphite (or other carbon allotropes) can be produced.

At scale, the MSCC-ET method can utilize CO_2 streams from hard-to-abate industries such as concrete, steel and chemical industries, preventing CO_2 to reach the atmosphere and instead immobilizing the emission within the carbon material. Using MSCC-ET, 3.7 kg of CO_2 can be processed into 1 kg of useful carbon materials, immobilizing the respective emissions for an indefinite amount of time given proper recycling streams.

Within this presentation, we present an overview on MSCC-ET technology, the application of the resulting materials and the requirements for the feedstock CO_2 gas. Example applications of CO_2 derived materials include construction materials, where CNTs from CO_2 increase the strength of concrete by up to 70%, not only immobilizing carbon emissions inside the concrete in the form of CNTs, but also reducing the overall emissions footprint as less concrete is needed for the same strength construction. Finally, additional results for applications in energy storage are presented. CNTs from CO_2 increase the power of Li-ion batteries, enabling them to store energy more efficiently.

This presentation will showcase the MSCC-ET technology in respect to its requirements to CO_2 feedstock, but also show clear calculations on the combined CO_2 emission reduction impacts of resulting carbon materials made from CO_2, considering multiple example applications.