

On the quest for Ca battery cathodes: the beauty and the beast

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Amongst multivalent electropositive metals, calcium is especially attractive as it is the fifth most abundant element on earth crust and its standard reduction potential is only 170 mV above that of lithium, enabling significantly larger cell potential than that achievable with magnesium. Moreover, Ca²⁺ would hold promise for faster reaction kinetics than Mg²⁺ (and thus better power performance) due to its lower polarizing character.

The electrochemical behavior of calcium electrodes in conventional alkyl carbonate electrolytes with large useful potential window has been achieved at moderate temperature.[1] These findings pave the way to exploratory screening and testing of potential cathode materials which would reversibly insert and deinsert calcium to assemble a full calcium based cell and achieve proof-of-concept. Electrochemical testing in three electrode cells and combination of complementary characterization techniques to assess calcium electrochemical insertion/extraction is mandatory to avoid biased results.

Candidate compounds should have a redox center, typically a transition metal, and involve a couple operating within the stability range of the electrolyte. Moreover, the crystal structure must exhibit pathways to enable diffusion of calcium ions. [2-4] Some compounds such as CaMoO₃ or CaMn₂O₄ which exhibit such features are found to exhibit too large barriers for calcium ion diffusion. Yet, preliminary results seem to indicate reversible electrochemical activity in other compounds.

References:

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