The Effect of V_2O_5 + TiO_2 Composite Cathodes on the Cyclability and Specific Capacity of Iron-Ion Batteries

Cudzich, Daniel (School: Niles Township West High School)

The purpose of this investigation is to improve the performance of iron-ion batteries (FIBs) by improving cyclability through composite V_2O_5 and TiO_2 cathodes. FIBs offer a higher specific capacity than lithium-ion batteries and require significantly cheaper materials, but FIBs currently suffer from durability issues. By applying TiO_2, battery lifetime can be improved for commercialization, allowing for applications in the renewable energy grid and electric vehicles. Battery cases were 3D printed to fit iron strips and carbon cloth. For each experimental group, ratios of 1:0, 1:1, 2:1, and 0:1 vanadium to titanium on the carbon cathode were tested using a TEGDME electrolyte. Batteries were discharged, with current and voltage measured. Afterwards, the batteries were intended to recharge using a 1.5 V AA battery before discharging four more times, with current and voltage observed. Amp-hours per gram were calculated for each discharge. There is not sufficient evidence to draw a conclusion about whether the hypothesis was supported. For most trials, currents, voltages, and specific capacities very close to zero were observed whose 2SEM bars intersected with zero and each other. With the exception of the 2:1 V:Ti group, all other cathodes yielded a p-value greater than 0.05 for significant difference from 0 Ah/g. The 2:1 V:Ti group had an average specific capacity of -4.38E-5 Ah/g, and while this is statistically significant with $p<0.05$, a negative specific capacity does not make sense. There was not enough V_2O_5/TiO_2 deposited on carbon cathodes, meaning that there was not sufficient V_2O_5/TiO_2 for intercalation. Electrodeposition is not adequate for cathode synthesis. A second round of investigation is using sol-gel electrophoresis for cathode synthesis is planned.

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