Rechargable Lithium-Air Batteries: Investigation of Redox Mediators Using DEMS - DTU Orbit (23/12/2018)

Rechargable Lithium-Air Batteries: Investigation of Redox Mediators Using DEMS

The rechargeable aprotic lithium-air battery is a promising technology that offers high theoretical energy density of as much 10 times the capacity of current Li-ion batteries. This type of battery technology differs from conventional batteries because of the gas exchange during discharge/charge cycling. Characterizing the gas content during charge using Differential Electrochemical Mass Spectroscopy (DEMS) allows for in-situ characterization of chemistry in the battery.

Using our DEMS setup we have investigated different cathode materials for lithium-air batteries. A carbon black cathode exhibits a flat discharge curve with low over-potentials until the "sudden death" phenomenon which causes the voltage to drop quickly. On the charge side however, this materials exhibits significant over-potentials. These high over-potentials are linked with CO2 development which indicates that the cathode material or electrolyte is being decomposed. This is also seen with Thermally reduced Graphene Oxide (TrGO). The graphene based cathode is interesting as it exhibits a high surface area which in turn increases capacity.

Using the additive LiI, functioning as a redox mediator, the discharge curve remains largely unchanged whilst the charge curve exhibits dramatically lower over-potential, throughout the experiment [1][2]. Under certain conditions the chemistry of the battery changes, resulting in a four electron process that produces the reversible discharge product LiOH rather than Li2O2 which is observed without the redox mediator [2]. This results in higher energy densities and ideally higher cyclability due to the lower over-potentials. Using DEMS we have investigated the gas evolved in the process to determine the electron to oxygen ratio using both cathode materials mentioned.

As has been shown with lithium-air batteries the water content affects the morphology of the discharge product[3]. The effect of changing experimental conditions such as varying water content will be reported.