Gamma-Aminobutyric Acid-Functionalized Naphthalene Diimide for Aqueous Organic Flow Batteries

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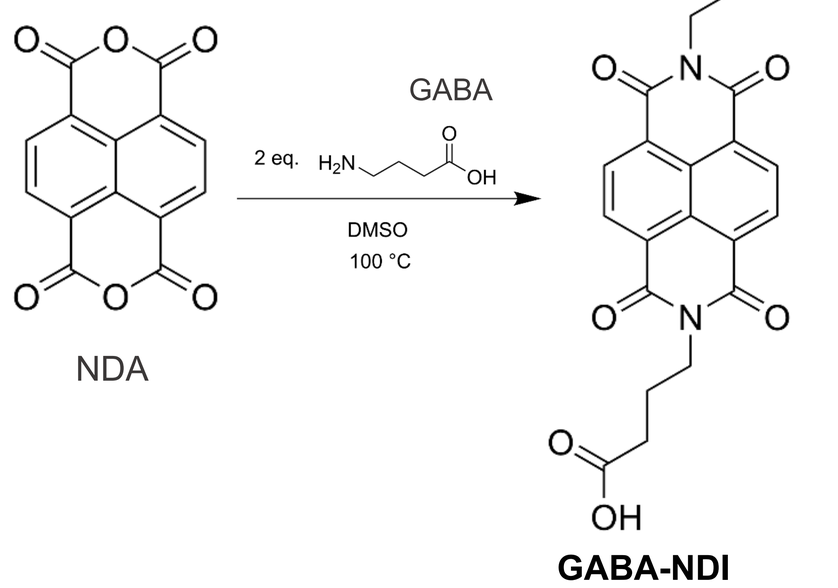
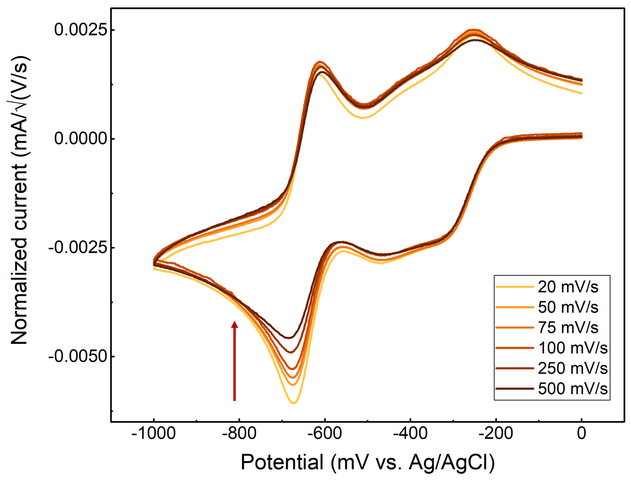
- Flow batteries utilizing organic molecules are considered as one of the low-cost energy storage systems
- 1,4,5,8-naphthalene diimides (**NDIs**) are one of the possible candidate molecules for FBs
- NDI molecules undergo a two-electron reduction reaction and also self-associate due to π–π stacking of their naphthalene core
- In the present work, electrochemical properties and cycling stability of gamma-aminobutyric acid-functionalized naphthalene diimide **(GABA-NDI)** were studied.

Synthesis

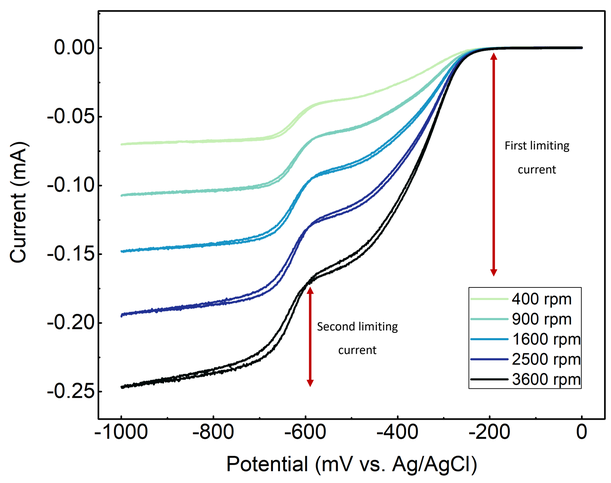


Scan Rate Normalized CV



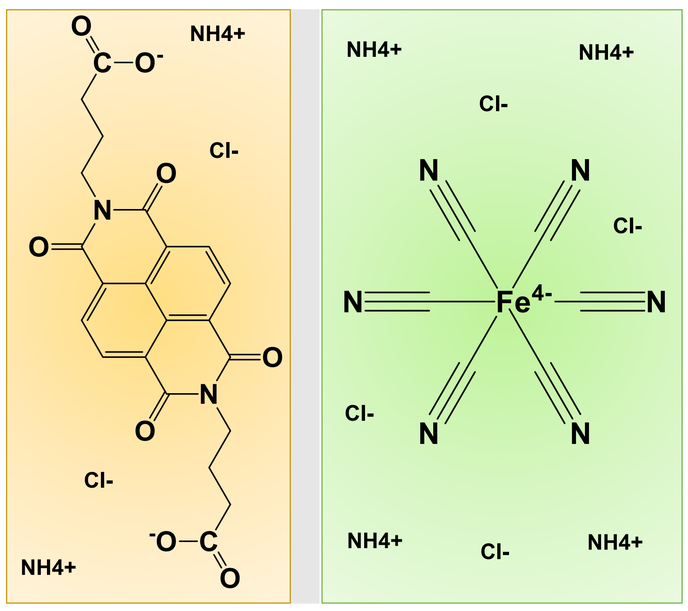
- Second reduction current decreases by increasing the scan rate
- Possible indication of a CE mechanism (chemical step followed by an electron transfer) related to dissociation of the dimer species

Rotating Disk Electrode



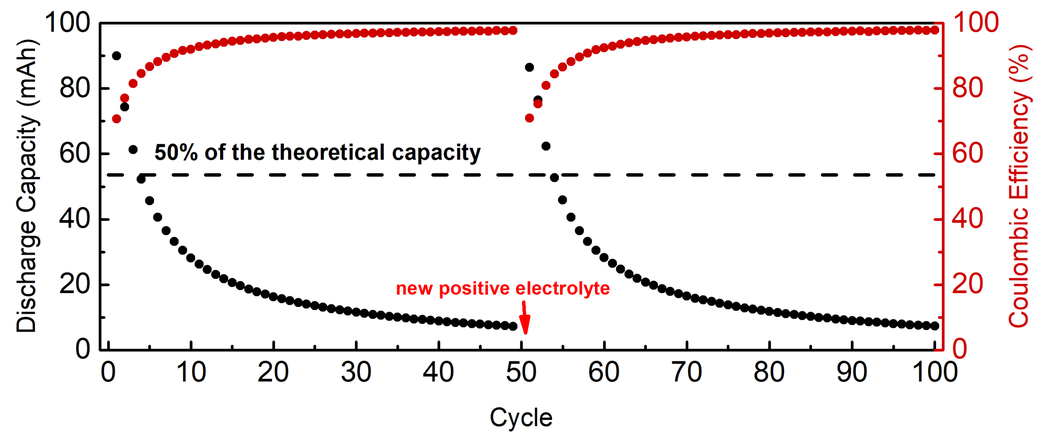
- First limiting current is much higher than the second one
- Indication of high degree of dimerization of the molecule

Battery Performance



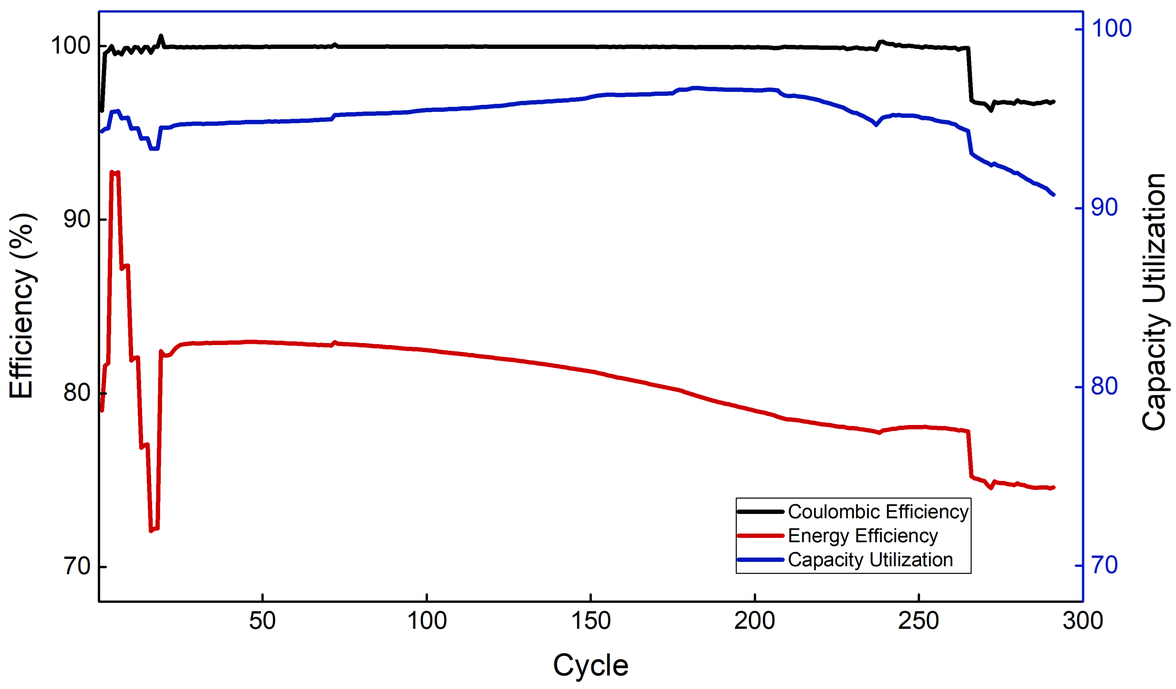
GABA-NDI/Ferrocyanide

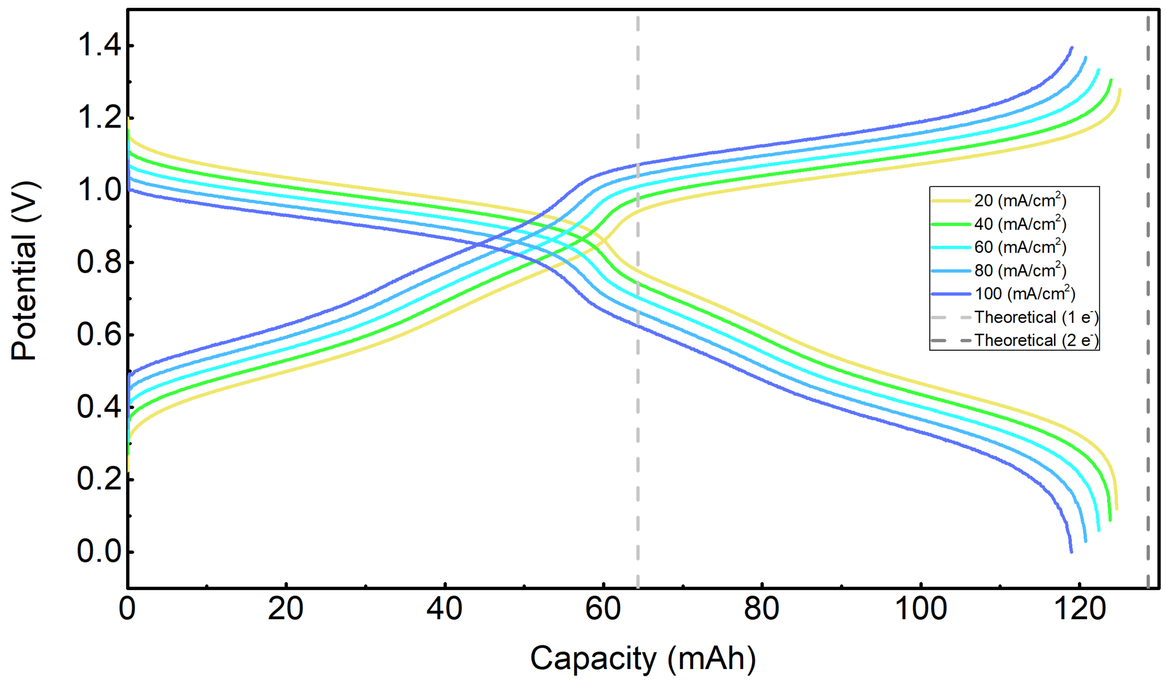
Battery Scheme



Cylced outside of Glovebox at 60 mA/cm²

Results: Oxidation of reduced GABA-NDI in the presence of oxygen





Cycled in Glovebox

- **At different current densities in the beginning**
- **Long time cycling at 60 mA/cm²**

Results

- Accessing more than 90% of the capacity at different current densities
- Fast kinetics and low ohmic resistance (High Energy Efficiency)
- Failure: due to the water transport and pH drop while cycling