Supporting information

Decoupling Energy Storage from Electrochemical Reactions in Li-air Batteries Towards Achieving Continuous Discharge

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Experimental

Materials: DEME-TFSI, LiTFSI (99.80%, Kishida Chemical) and all other materials were used as purchased without further purification.

Li-air battery evaluation: A supply gas for ORR is pure O_2. Li-metal (FMC corp.) with 0.2 mm of thickness was used as an anode. 1 M LiTFSI dissolved in propylene carbonate (Kishida chemical) was used as an electrolyte for anode side. All electrochemical evaluation was done in a temperature chamber kept at 25ºC. The evaluation cell is custom-made and has a cathode chamber with 19 mm of its diameter. A cathode (carbon paper) was located on top of a 5 mm-thick spacer and 1.4 ml of the electrolyte was used for evaluation.

Analysis: Raman spectroscopy measurements were performed using a Horiba Scientific LabRAM HR800 with a 532 nm laser. The samples were transferred in quartz vial in inert environment using globe box and analyzed directly through the quartz window without opening the vial.

Scanning electron microscope measurements were performed using a JEOL 7800FLV microscope. Carbon paper cathodes after discharge were washed and rinsed acetonitrile three times, and dried before observation.

Capacity estimation

Energy density of the new Li-air battery was estimated based on following assumption and shown in Figure S1.

Certain volume of Li_2O_2 (for example, 1 ml) was assumed to be produced in reservoir after complete discharge. Required volume of Li metal was calculated, and then total volume of the reservoir and cell were also calculated as a function of "discharge product/reservoir volume ratio" and "reservoir/cell volume ratio". Discharge voltage used in the calculation was 2.7 V.
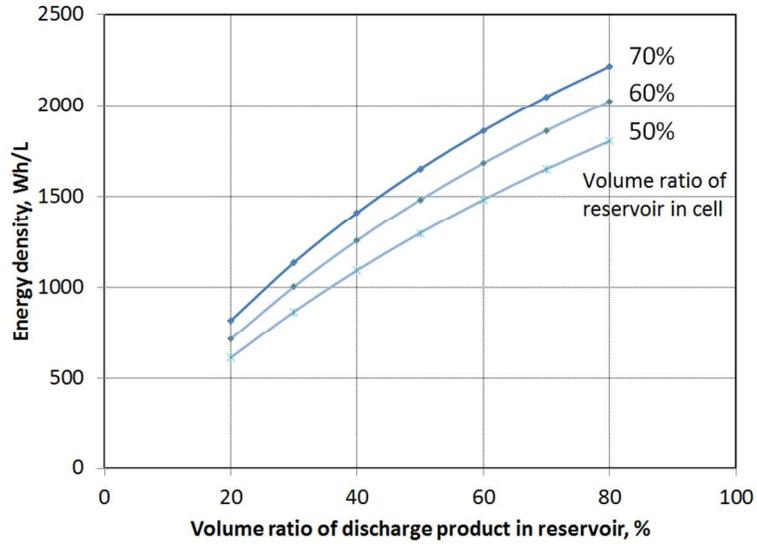
Figure S1 Estimated energy density as a function of volume ratio of discharge product in reservoir.

Battery configuration Li-ion free and stirring electrolyte
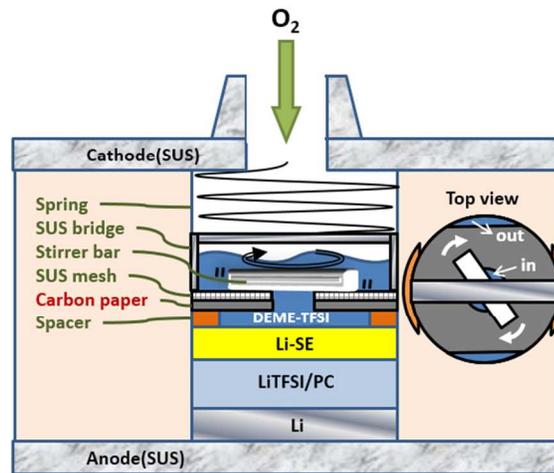
Figure S2 Battery configuration for stirred electrolyte system in Li-ion free Li-air battery. The stirring speed is 500 rpm.