Condensed Matter & Biophysics Seminar

Nanostructured Cathode Architecture for improving performance of Li-02 battery

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The lithium-oxygen battery has received significant interest because of its extremely high theoretical energy density, which exceeds that of any other existing energy storage systems. One of the main challenges faced by the development of Li-O2 batteries is the high overpotentials on discharge and in particular on charge. A large overpotential during charge, even at very low current densities, results in very low round-trip efficiencies (<60%), low power capability and poor cycle life. Here report a cathode architecture based on nanoscale components that results in a dramatic reduction in charge overpotential.[1-3] The cathode utilizes atomic layer deposition (ALD) of palladium nanoparticles on a carbon surface with a passivation coating of carbon defect sites. The low charge potential is enabled by the combination of palladium nanoparticles attached to the carbon cathode surface, a nanocrystalline form of lithium peroxide with grain boundaries, and the coating preventing electrolyte decomposition on carbon. As a consequence, the air cathode based on this modified architecture shows promising results for solving the charge overpotential problem, and provides the basis for future development of lithium-oxygen cathode materials that can be used to improve the efficiency and to extend cycle life.

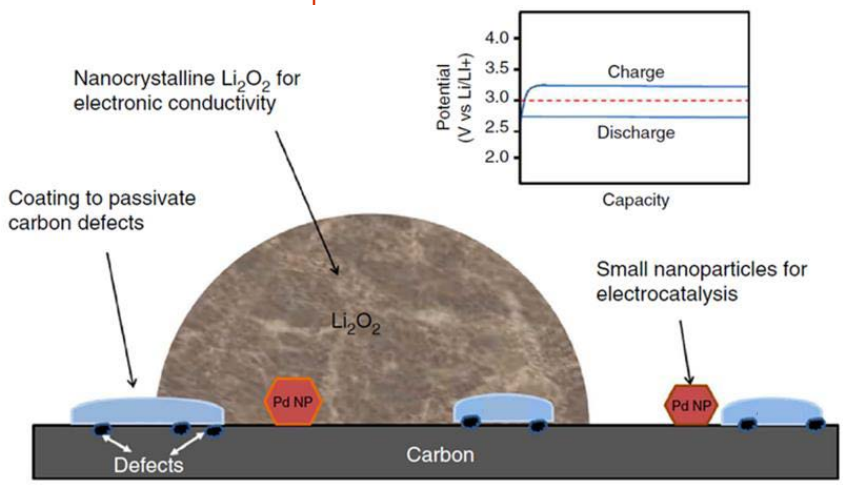

Figure 1. Schematic of the nanostructured cathode architecture. This figure shows the passivation coating, the palladium nano-particles and the nanocrystalline lithium peroxide, all of which contribute to lower-ing the overpotential. The inset shows a hypothetical charge/discharge voltage profile versus capacity.

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Reference: [1] X Luo, M Piernavieja-Hermida, J Lu, T Wu, J Wen, Y Ren, D Miller, ZZ Fang, Y Lei, and K Amine. ***Nanotechnology***, 2015, *26*, 164003.
[2] Y Lei, J Lu, X Luo, T Wu, P Du, X Zhang, Y Ren, JT Miller, YK Sun, JW Elam, and K Amine. ***Nano Lett.***, 2013, *13*, 4182-4189.
[3] J Lu, Y Lei, KC Lau, X Luo, P Du, J Wen, RS Assary, U Das, DJ Miller, JW Elam, HM Albishri, DA El-Hady, YK Sun, LA Curtiss, and K Amine. ***Nat. Commun.***, 2013, 4: 2383.

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