

# Palladium Nanoparticles on ZnO-Passivated Carbon for Enhanced Performance in Li-O<sub>2</sub> Batteries

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## INTRODUCTION

Lithium-oxygen has extremely high theoretical energy density. Main challenges in lithium-oxygen batteries:

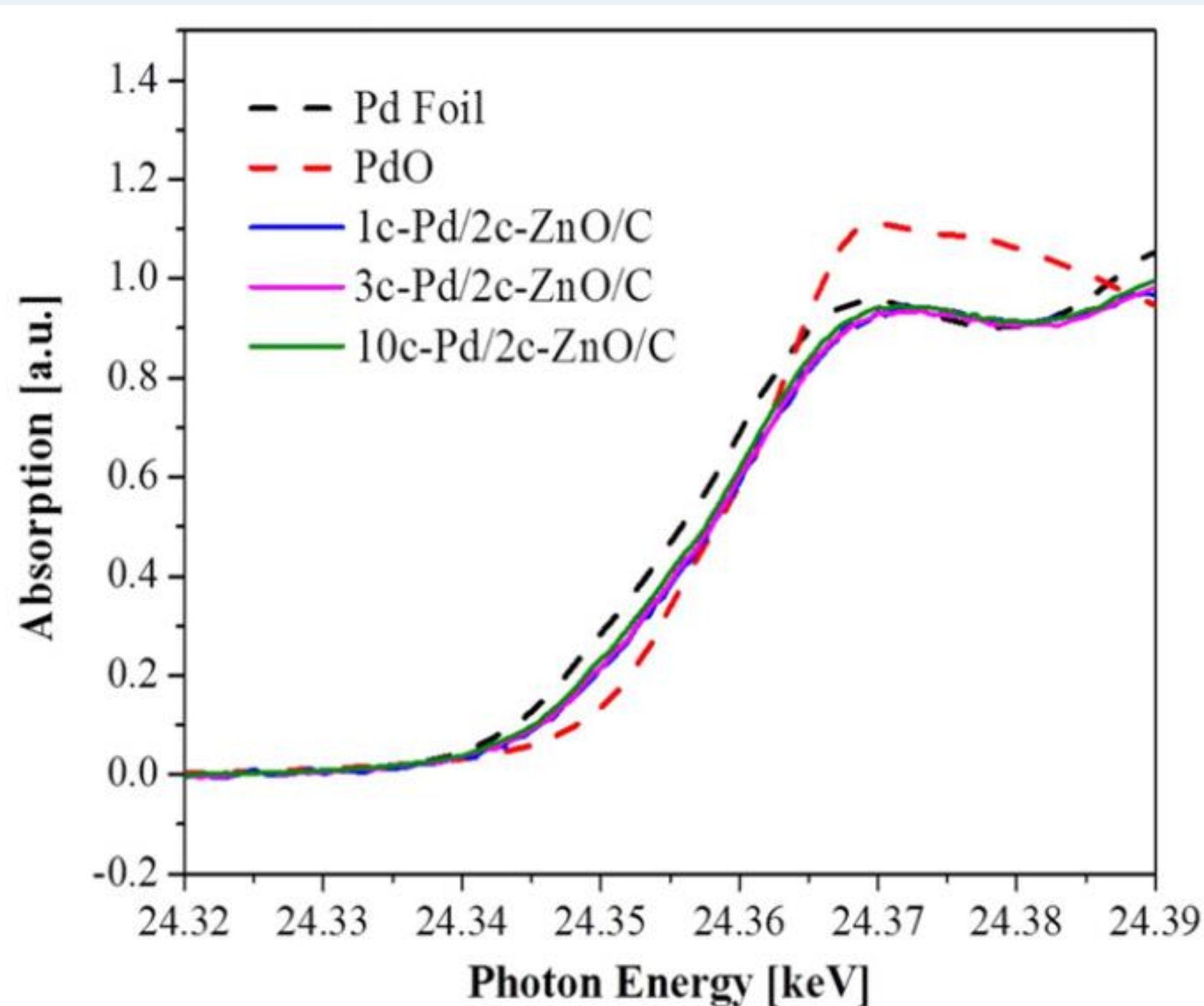
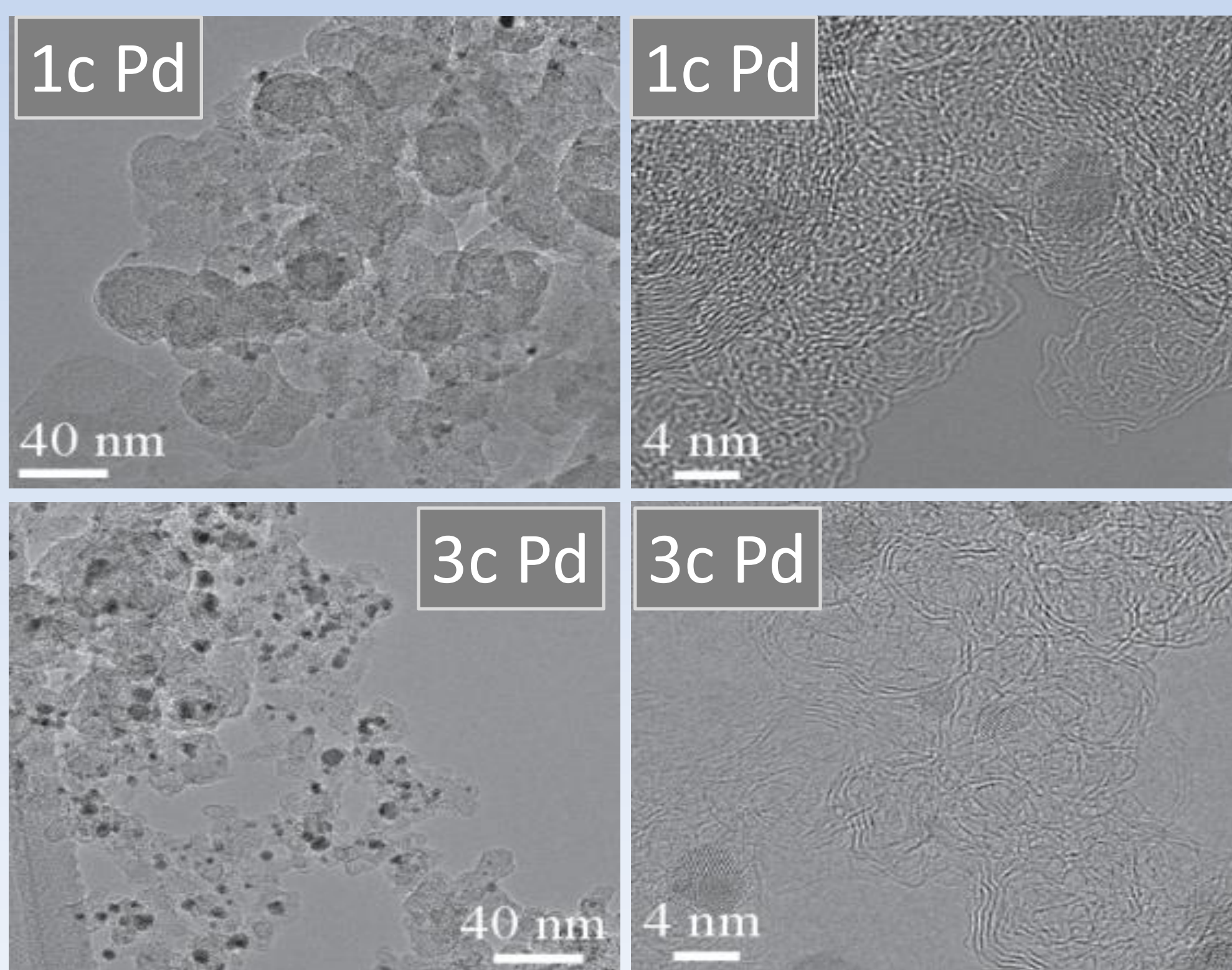
- low round-trip efficiencies (<60%); low power capability; and poor cycle life

In this study, we demonstrate that a cathode electrocatalyst consisting of palladium supported on ZnO-passivated porous carbon shows:

- Higher electrochemical catalytic activity in a Li-O<sub>2</sub> cell than the Pd/Al<sub>2</sub>O<sub>3</sub>/C cathode architecture.
- Reduction of the charge overpotential to almost 0 V, which is the lowest ever reported.

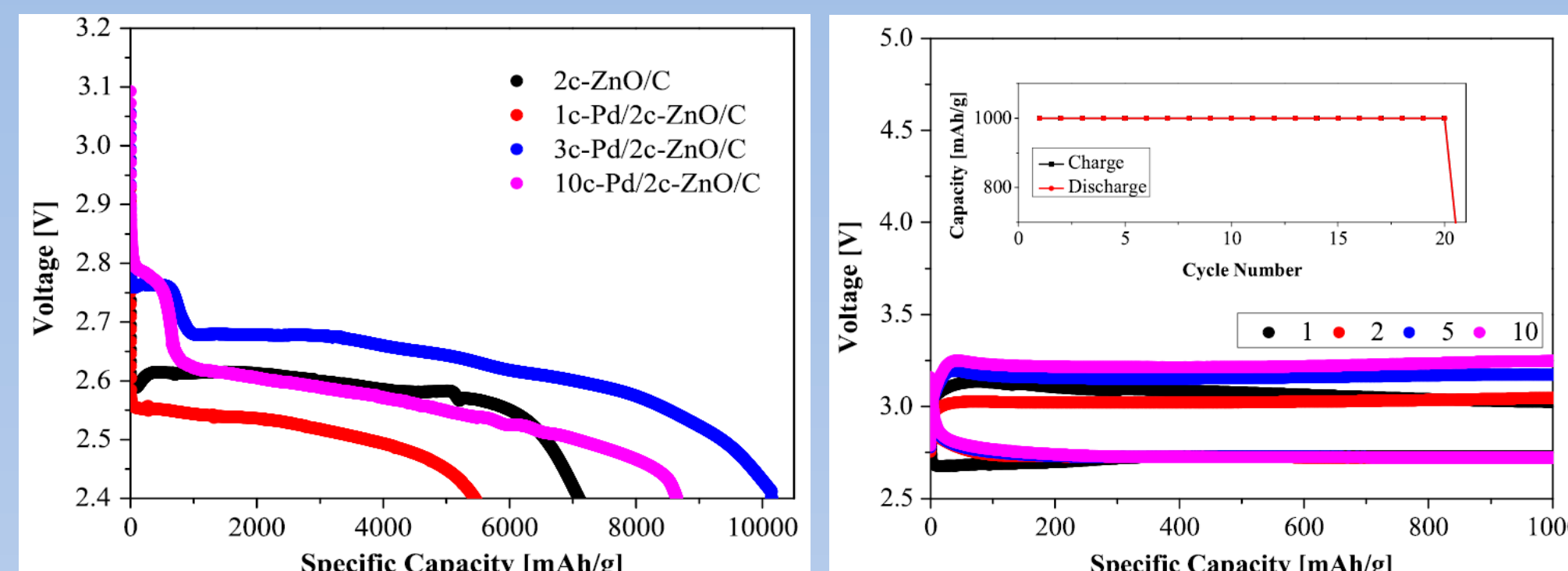
## CHARACTERIZATIONS

The Pd/ZnO/C electrocatalysts were prepared using atomic layer deposition (ALD). TEM images show the diameter of the Pd nanoparticles increases with increasing ALD cycles.

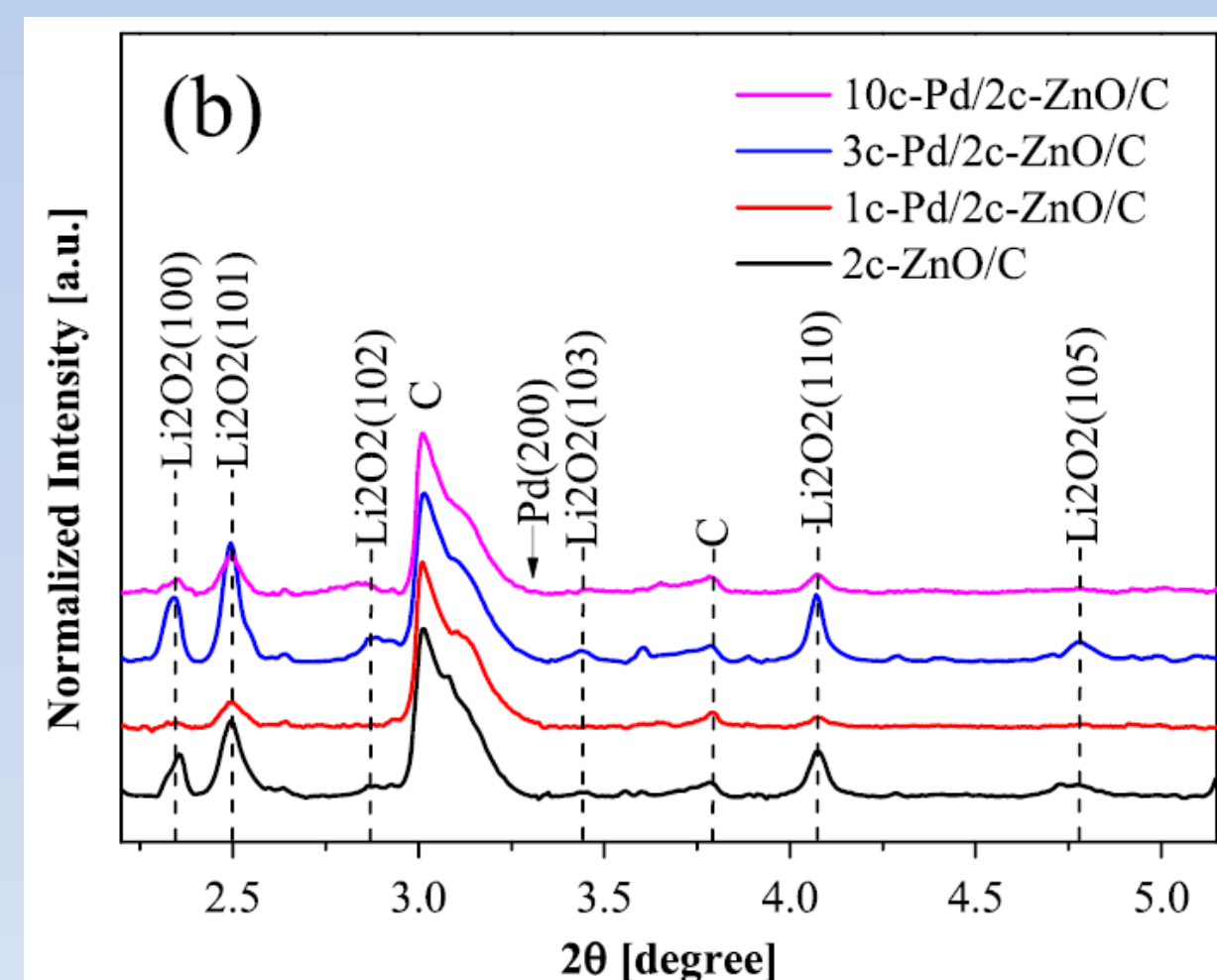


## Li-O<sub>2</sub> BATTERY PERFORMANCE

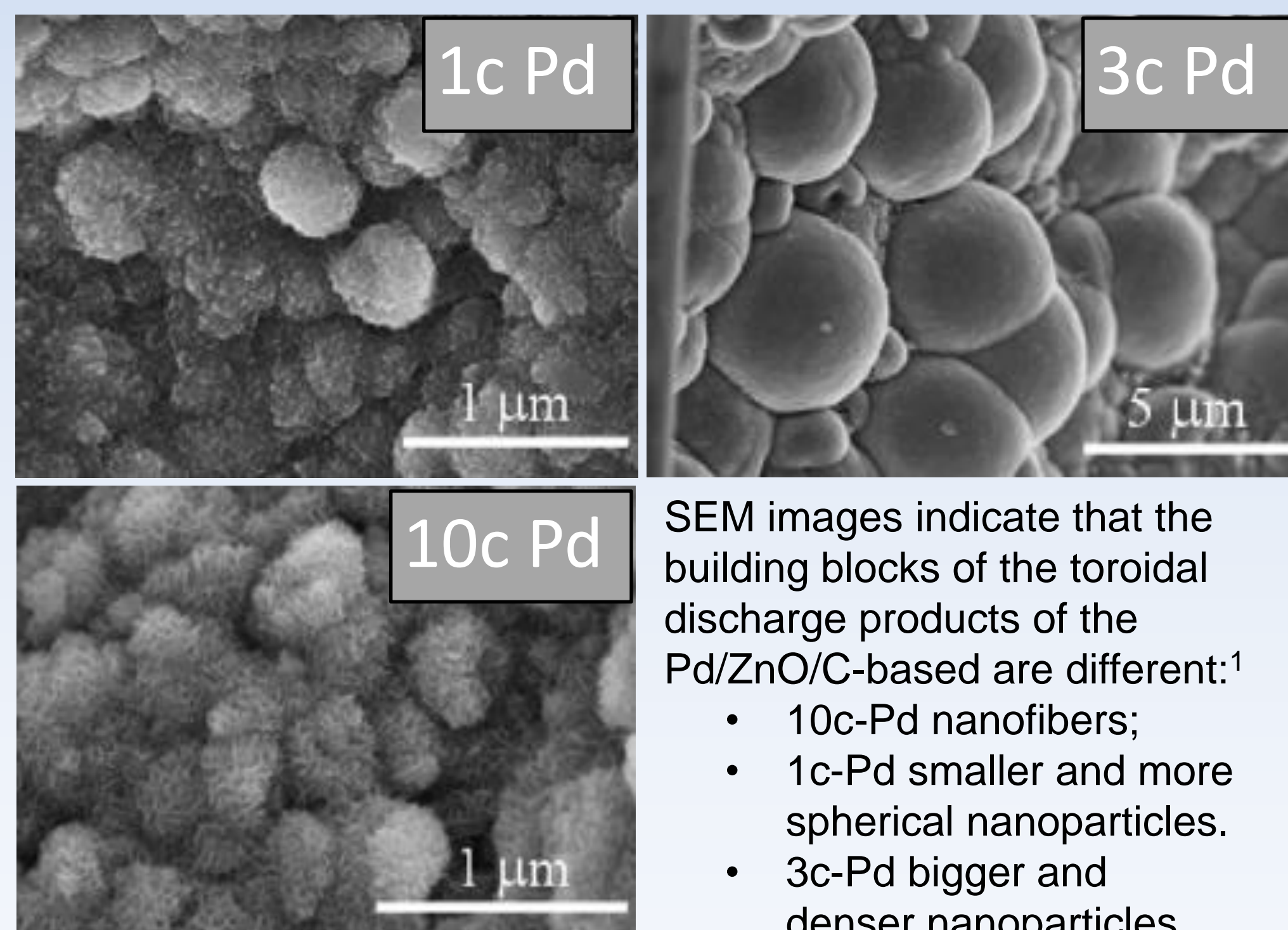
Voltage profiles of the first discharge at 2.4V under a current rate of 100 mAh g<sup>-1</sup> for all samples is presented.<sup>1</sup>



## MECHANISMS



X-ray diffraction (XRD) patterns illustrated the formation of Li<sub>2</sub>O<sub>2</sub> as the main discharge product on the cathodes.<sup>1</sup>



SEM images indicate that the building blocks of the toroidal discharge products of the Pd/ZnO/C-based are different:<sup>1</sup>

- 10c-Pd nanofibers;
- 1c-Pd smaller and more spherical nanoparticles.
- 3c-Pd bigger and denser nanoparticles.

## CONCLUSIONS

- ALD successfully deposited palladium on ZnO-passivated porous carbon as the cathode material for Li-O<sub>2</sub> cells.
- ALD Pd/ZnO on carbon is an effective cathode for:
  1. Decreasing the charge potential of LiO<sub>2</sub> batteries.
  2. Leading to a high round-trip efficiency of the cell.
  3. Reduction of the charge overpotential.

## REFERENCES

- [1] Luo X, Piernavieja-Hermida M, Lu J, Wu T, Wen J, Ren Y, Miller D, Fang Z Z, Lei Y and Amine K 2015 Pd Nanoparticles on ZnO-Passivated Porous Carbon by Atomic Layer Deposition: an Effective Electrochemical Catalyst for Li-O<sub>2</sub> Battery *Nanotechnology*. **26** 164003.