Effective model for Sodium insertion in Hard Carbon

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Abstract
Sodium ion batteries (NIB) are a potential alternatively for Lithium ion batteries (LIB) because of lower cost and more abundance. As anodes, Hard Carbon (HC) seems to be the most promising candidate for NIB with advantages: stable cycling, large specific capacity, and low-cost precursors. Previous theoretical researches studied general conditions for Na insertion in HC; while experimental studies proved that the properties of Na insertion in HC depend strongly on specific properties material of HC. Our target is building an effective model which can link theoretical researches in general conditions and experimental phenomena for specific materials of HC. In our effective model, HC are treated implicitly; while Na are modelled in the confined space, created by HC. To describe the complexity of Na behaviour in HC, different types of Na with different energy level are introduced, figure 1. The results consist with experimental data; and clarify the contribution of types of Na in open circuit voltage, as well as capacity loss of Na in HC[1].

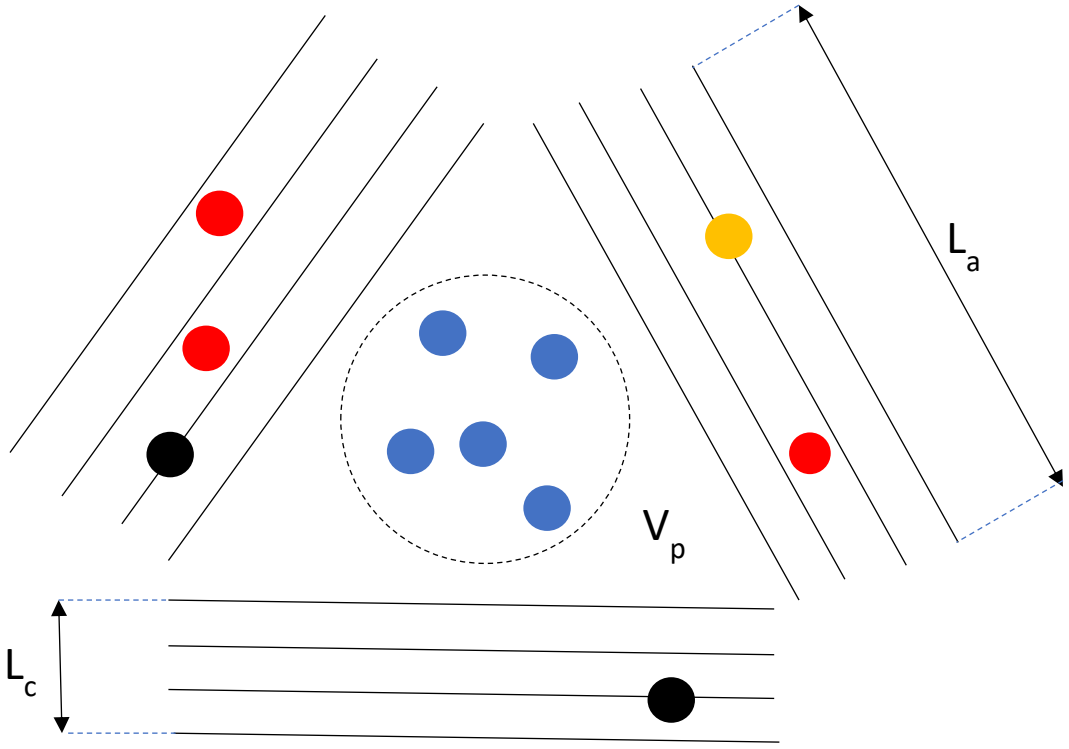

Figure 1: The schematic of effective model for Na insertion in Hard Carbon.

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References
[1] H. S. Nguyen and A. Latz, *Phys. Chem. Chem. Phys.*, 2023, **25**, 28196 – 28204, DOI: 10.1039d3cp03186a.