Electrochemistry under confinement: 2D materials for energy storage applications

Kangkang Ge
Pierre-Louis Taberna, Patrice Simon

Université de Toulouse, CIRIMAT UMR CNRS 5085, 118 Route de Narbonne, 31062 Toulouse, France
Réseau sur le Stockage Electrochimique de l'Energie (RS2E), FR CNRS 3459, France
patrice.simon@univ-tlse3.fr

Understanding the electrochemical processes occurring at the electrolyte/electrode interface is of key importance for improving the charge storage in battery electrodes. The degree of interaction between ions and the host material is highly related to the charge storage mechanism, with mainly two processes clearly identified: (1) electrostatic, non-Faradaic electrosorption of fully solvated ions forming the electric double layer (EDL), known as the capacitive charge storage, and (2) Faradaic process with full charge transfer to the host material following by the intercalation of fully desolvated ions such as Li, Na... occurring in the last generation of alkali metal-lion battery electrodes (see Figure). In this work, we used 2D materials as model materials to understand how the confinement of electrolyte between the interlayer spacing affects the charge storage capacity by using advanced electrochemical techniques. Electrochemical Quartz Crystal Microbalance (EQCM), and Electrochemical Dilatometry (ECD) were employed to track ion fluxes during cation insertion in 2D materials such as rGO and MXene [1-2]. The results highlight the key role of electrolyte-material interactions and suggest that the observed improvements in electrochemical performance could be attributed to partial desolvation of electrolyte ions due to their confinement in interlayer spacing [3,4]. Understanding confined electrochemical systems and coupling between chemical, electrochemical, and transport processes in confinement may open tremendous opportunities for designing materials with improved performance for energy storage applications.

References

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Figures

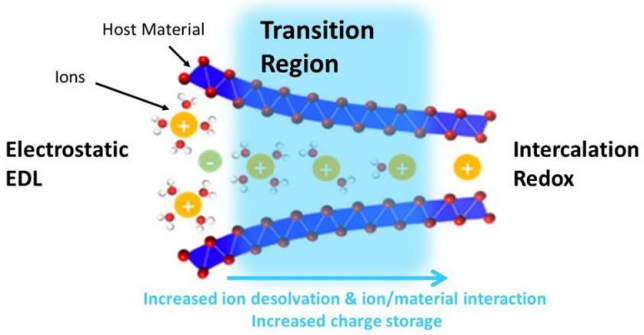

Figure 1: Transition in the charge storage mechanism when increasing the confinement of ions inserted in a host structure. The ion desolvation resulting from confinement increases the capacity.