Rational Design of Graphene-Based Materials for Supercapacitors

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Energy storage systems such as electrical double-layer capacitors (a.k.a. supercapacitors) are essential components of the renewable energy paradigm. Today, the widespread use of carbon materials as electrodes of supercapacitors is justified, for instance, by their remarkable electrical conductivity, chemical stability and wide range of operating temperatures. Still, current technology has not yet approached the maximum theoretical capacitance for pure carbon-based electrode materials (550 F/g) [1]. While recent literature has repeatedly investigated the use of chemically exfoliated graphene for supercapacitors [2,3], a systematic study on how different synthesis strategies affect the structure and chemistry of reduced graphene oxide (rGO) is missing. Likewise, steps such as the drying methodology have been mostly overlooked.

In this presentation, I will describe our strategy to rationally approach the synthesis of rGO materials [4,5] and how this enabled considerable improvements in electrochemical capacitance. We observed that, besides a judicious selection of the graphite's oxidation–reduction route, it is critical to control the final drying step. Through it, one can significantly increase the specific surface area of the rGO powder and preserve its porous network (Fig. 1), thereby maximizing the supercapacitance performance. In these circumstances, while previous studies on hydrothermally reduced GO invariably reported low surface area (<100 m^2/g) and capacitance (<300 F/g) (cf. for instance ref. [3]), we achieved unprecedented values of 364 m^2/g and 441 F/g, respectively. [6]

References

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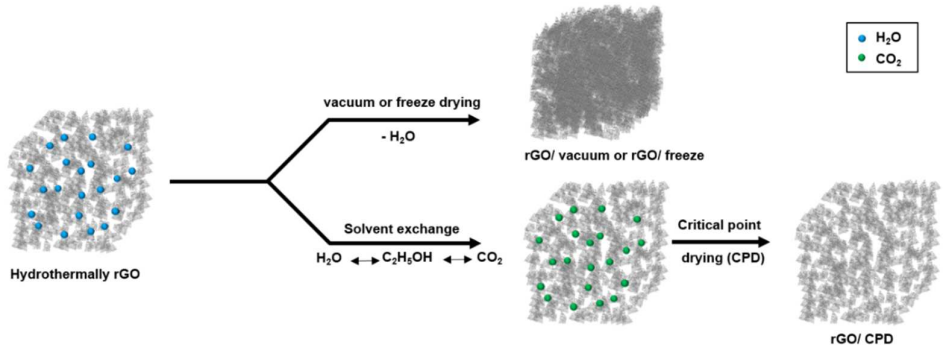

Figure 1. Schematics of the various drying processes that were investigated.