**CVD-coated carbon xerogels with various nodule size for high performance Na-ion battery negative electrode**

C. Sustainable materials for chemical and electrochemical energy storage II

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**Abstract**

Carbon xerogels (CXs) are used as hard carbons for Na-ion battery (NIB) electrodes. These materials are made of microporous carbon nodules, the size of which can be tuned (from 20 nm to 2 µm); they are obtained by pyrolysis at 800°C of resorcinol-formaldehyde resins. However, when used in NIBs, their high specific surface area (~600 m²/g) leads to low Initial Coulombic Efficiency (ICE) due to electrolyte decomposition. To cope with that issue, Chemical Vapor Deposition (CVD) by ethylene cracking at 650-700°C is used to fill or mask the micropores. In the case of non-coated materials, large nodules (2 µm) lead to high Na+ storage capacity (248 mAh/g at C/20 cycling rate) and ICE (up to 80 %); quite notably, and contrarily to what is usually stated in literature, those are independent on the specific surface area measured by gas sorption. More probably, it depends on the surface that can really be accessed by the electrolyte, which could exclude part of the micropores volume when the nodules are large. In the case of the coated samples, the CVD-deposited carbon layer blocks the micropores; as a result, the specific surface area drops and both reversible capacity and ICE increase up to 298 mAh g-1 and 84 %, which is remarkable for carbons processed at such a low temperature (< 1000°C). Finally, electrochemical response to speed cycling depends on the nodule size. These carbon-carbon composite materials show great promise as materials for Na-ion batteries.