CREATING NEW GENERATIONS OF ELECTROCHEMICAL MATERIALS BY EXPLOITING SOL-GEL CHEMISTRY

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ABSTRACT:

The projected doubling of global demand for electricity by 2050 has stimulated a worldwide effort at developing sustainable energy strategies. A vital part of meeting this demand is the growth of electrochemical energy storage technologies. All evidence indicates that energy storage technologies will continue to grow, driven by expanding markets for mobile consumer electronics, the electrification of transportation and the increasing integration of renewable technologies into the energy grid. Because of its extraordinary flexibility, sol-gel chemistry has played a critical role in the development of electrochemical energy storage technologies and will continue to do so in the future. The overarching reason is that sol-gel chemistry offers an incredible breadth of opportunities for energy storage. The sol-gel process goes well beyond the ability to simply synthesize compounds and non-crystalline solids. By controlling the chemistry of the process, there is the opportunity to produce an extraordinary range of compositions, from insulating materials to electrochemically active transition metal oxides, from solid electrolytes to high performance anodes and cathodes for next generation electrochemical systems. Moreover, one can create materials with designed architectures; from fully dense materials to high porosity, high surface area aerogels. In this paper, we review some of the more significant contributions to the field of electrochemical energy storage which have been enabled by sol-gel chemistry. This includes current applications and future directions for battery and capacitor materials. We also highlight pseudo-solid-state materials, which are based on confining a low vapor pressure solvent, such as an ionic liquid, within the mesoporous network of a sol-gel derived inorganic matrix. The nanoscale fluidic state and the related questions of confinement and tortuosity are key features in the design of electrolytes and electrode architectures for next generation lithium and sodium metal batteries.

Figure 1 : Title 1

References

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