New routes towards the formation of tin oxide inverted opals for charge storage applications

M. Osiak[1], E. Armstrong[1], and C. O'Dwyer[1,2]

[1] *Applied Nanoscience Group, Department of Chemistry, University College Cork, Cork, Ireland*
[2] *Micro & Nanoelectronics Centre, Tyndall National Institute, Lee Maltings, Cork, Ireland*

The formation of ordered porous structures has been a topic extensively researched over a number of years[1]. Particularly, inverted opal (IO) structures formed by infilling an ordered particle template, and subsequent thermal or chemical removal of the template, have attracted much attention due to excellent control over the pore size and arrangement. Moreover, a variety of IO template preparation methods as well as precursor chemistries make IO structures with a range of potential applications an exciting possibility[2]. Additionally, disordered porous structures, also called photonic glass (PG), have been recently reported[3] and scope exists for further characterization of photonic glasses of different materials.

Amongst materials that have been used to prepare IO structures, tin oxide (TO) offers potential for a variety of applications, such as photonics[4], gas sensing[5] and charge storage[6], due to large band gap and theoretical lithium storage capacity. However, the influence of the precursor chemistry on the structure of the IO and PG structures needs to be investigated further.

Existing procedures to synthesize IOs of SnO_2 employing $SnCl_2$, $SnCl_4$ and other[7,8] precursor solutions yield materials with walls of the IO structure being predominantly dense. To our knowledge, within the vast quantity of reports on 3-dimensionally porous structures, either crystalline, amorphous, ordered or disordered, neither IO synthesis by Tin(IV) isopropoxide solutions (though being reported for the synthesis of for instance thin films) nor the formation of SnO_2 inverted opal 3-DOM photonic crystals with mesoporous walls has been reported to date.

Here, we will present a facile new route for the formation of IO and PG structures of large area, and correlate the influence of the precursor used on the structure of the resulting IO and PG structures. Further, the performance of IOs and PGs as a lithium ion battery anode will be presented and correlated to the precursor chemistry and the hierarchical porosity and crystalline structure.

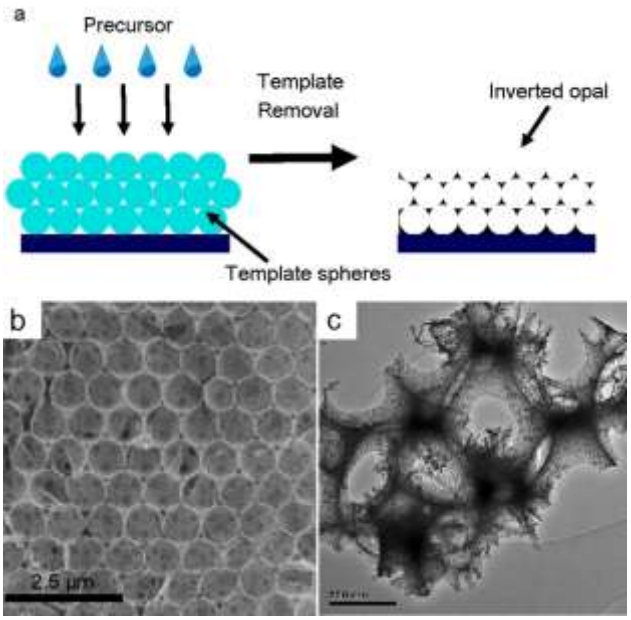

Fig. 1. (a) Schematic diagram of Inverted opal (IO) formation procedure. (b). SEM image of tin oxide IO using tin (II) acetate as a precursor. (c) TEM image of the structure of IO prepared from tin(II) acetate.

References

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