Porous Monolithic Electrodes Prepared via Sol–Gel Processes

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ABSTRACT:

To realize a prosperous and sustainable society in the future, continuous progress in electrical energy storage technology is essential. Sol–gel technology has largely contributed to the development of electrode materials in terms of the synthesis of nano-sized and/or nanostructured particles, which offer enhance electrode performance owing to abundant active sites. However, the powdery nanomaterials need to be fixed on an electrode substrate by mixing with binders and conductive agents, resulting in so-called composite electrodes. These additives make it difficult to correlate physicochemical characteristics of an electrode material with electrochemical properties of a composite electrode thereof. In addition, it is impossible to control the porous morphology of a composite electrode because of the uncontrollable pore properties of interparticle gaps. In this context, free-standing and binder-free monolithic electrodes with rationally designed porous structures have emerged as an advanced electrode material. Various sol–gel techniques can be utilized to tailor porous structures at different length scales in monolithic gels, and the subsequent heat-treatment allows for the conversion into porous monolithic electrodes.

In the award lecture, the syntheses, pore controls and electrochemical investigations of porous monolithic electrodes characterized by three-dimensionally interconnected macroporous structures will be introduced. The synthetic strategy for electro-conductive porous monoliths is predominantly based on the sol–gel process accompanied by phase separation [1]. The insights obtained with the porous monolithic electrodes in battery and supercapacitor systems will be presented as well [2].

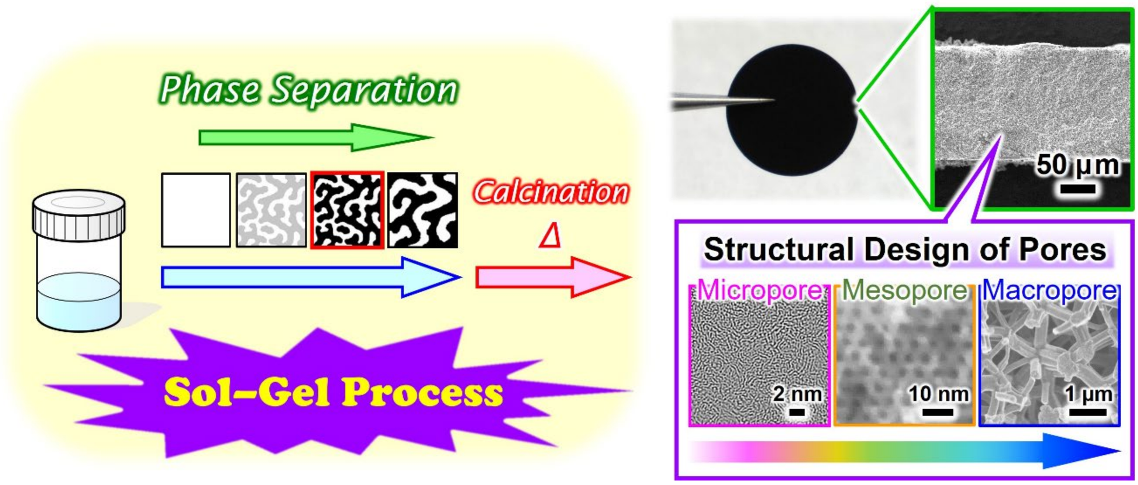

Figure 1 : Synthesis and pore control of a porous monolithic electrode by the sol–gel process accompanied by phase separation.

References

1- Nakanishi K (1997) J. Porous Mater. 4: 67-112

2- Hasegawa G (2022) J. Sol-Gel Sci. Technol. DOI: 10.1007/s10971-022-05862-5