

New Precursor Concepts for Nanostructured Sol-Gel Materials

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Abstract:

Modification of metal alkoxide precursors by organic ligands has been used to allow controlling the precursor reactivity, introducing organic functionalities etc. A new approach is to integrate groups which control the mutual arrangement of individual building blocks or the network structure in general.

“Single-source” sol-gel precursors are normally employed to prepare oxide materials containing two different (metallic or semi-metallic) elements. The option to use bimetallic precursors (modules) to pre-organize the individual components and thus to control the structure/texture of the formed mixed metal oxide has hardly been pursued until present. To this end, individual metal-containing moieties are linked through organic groups which are retained during sol-gel processing and degraded afterwards. Examples of such precursors are shown in the Scheme. This synthesis concept can also be used for the preparation of various nanocomposite systems and can be extended to silicon-free precursors.

Another example is modifying ligands with functional organic groups. For example, if the group R' in the oximate-modified titanium alkoxide (left) is a long hydrocarbon chain, surfactant-like properties are complemented. Sol-gel processing of such precursors results in similar structures as surfactant-assisted sol-gel processing of the corresponding native alkoxides, viz. networks of anatase nanoparticles.

