Nano-fabrication of metal/heterometal oxides nanostructures using sol-gel process

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Abstract

Metal/heterometal oxides nanostructures play an important role in materials science applications. Several applications such as photo-catalysis, in waste water treatment, lithium ion batteries, microelectronic circuits, solar cells, as sensors, as piezoelectric devices have been reported in literature. Earlier approach to synthesis was through solid state chemistry route, but in the recent years alternate approach using solution techniques have emerged, including co-precipitation, sol-gel process, hydrothermal processing, and solvothermal methods for fabrication of oxides nanostructures. Among these, sol-gel is a versatile method for the growth of nanostructures, such as nanorods, nanowires, nanobelts and hierarchical nanostructures, due to its simplicity, easy handling process and capability to control over grain size. Metal alkoxides are commonly used precursors for the synthesis of oxides nanostructures. The modification in metal alkoxides *i.e.* substitution of alkoxo group by chelating ligands such as oximes, β-ketones, schiff's base, glycerols, etc.; changes electronic environment of the precursor, which affects the kinetics of hydrolysis as well as condensation reactions, leads to altered morphology and functionality of oxides nanostructures. The introduction of modifiers not only generates steric effects, but also increase the gelation time and maintained the viscosity of the sol.

The present authors have experimented to modify the precusors of aluminum and titanium alkoxides, and also studied the effect of precursor chemistry on the morphology and size of the nanostructured metal/heterometal oxides by sol-gel technique. The paper presents the approach to modify the precusors of aluminum and titanium alkoxides, leading to modified nanoparticles with altered morphology. The nano-structures so obtained were found to possess better anti-scratch and anti-corrosive properties, making them an attractive possibility for surface protective coatings.

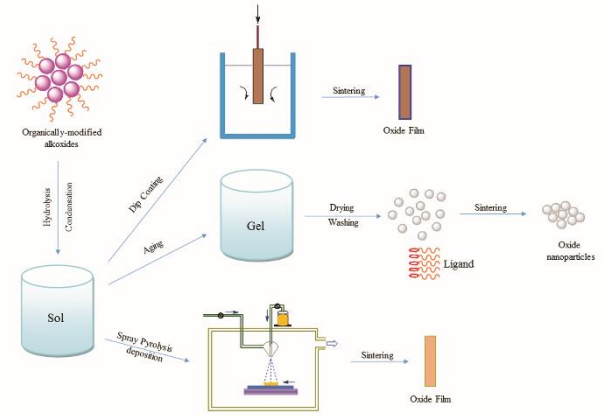


Fig. : Schematic oxide nanostructures fabrication using Sol-Gel Process.

Recent Publications

1. Saini A, Jat SK, Shekhawat DS, Kumar A, Dhayal V, Agarwal DC (2017) Oxime-modified aluminium(III) alkoxides : Potential precursors for γ-alumina nano-powders and optically transparent alumina film. Materials Research Bulletin 93:373-380.
2. Atal MK, Saini A, Jat SK, Rathore KS, Dhayal V (2017) Synthesis and characterization of oxime-modified phynylimido vanadium(V) isopropoxide and their hydrolytic study. Journal of Sol-Gel Science and Technology 83:281–290.
3. Atal MK, Saini A, Gopal R, Nagar M, Dhayal V (2017) Synthesis and characterization of a new class of single-phase AlVO4 precursors. Materials Research Innovations 21:172-176.
4. Atal MK, Sharma R, Saini A, Dhayal V, Nagar M (2016) Synthesis and characterization of organotin(IV) semicarbazones : Potential precursors for nanosized tin oxide. Journal of Sol-Gel Science and Technology 79:114-121.
5. Dhayal V, Chaudhary A, Choudhary BL, Nagar M, Bohra R, Mobin SM, Mathur P (2012) Molecular precursors for the preparation of homogeneous zirconia-silica materials by hydrolytic sol-gel process in organic media. Cyrstal structures of $[Zr\{OSi(O^tBu)_3\}_4(H_2O)_2].2H_2O$ and $[Ti(O^tBu)\{OSi(O^tBu)_3\}_3]$. Dalton Transactions 41:9439–9450.



Biography

Ajay Saini is pursuing his PhD in "Nano-fabrication of oxides nanostructures and their application" under the supervision of Dr. Veena Dhayal, Assistant Professor, Manipal University Jaipur. He is a qualified professional, engaged in hands-on R&D work in industry as well as in the academic research projects He has expertise in the synthesis, design, and characterization of materials (Organic moieties and nanomaterials) using various spectroscopic techniques. He has published 4 research papers in international journals of high repute and presented 5 research papers in national and international conferences.

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Notes/Comments: