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Short Communication

Aspects of Hydrothermal Synthesis for the Production of Eco-Friendly Products

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DESCRIPTION

Global warming and other natural disasters are evidence for the harmful effects in climate change driven by anthropogenic activities which mainly originate from uncontrolled use of the fossil fuels to meet world energy demands. Nearly 200 countries signed legally binding treaties in the agreement to reduce greenhouse gas emissions and control the rise in the global temperature. In 2021 this commitment was renewed with more ambitious climate goals during the 26th conference of the parties. The agreement established a gradual reduction in fossil fuels and coal use. So that Hydrothermal Synthesis done for functional materials for production of nature friendly materials [1, 2].

Hydrothermal synthesis

Hydrothermal synthesis of materials can be conventionally performed from room temperature to very high temperatures. First application of the hydrothermal process for nanomaterial synthesis was done in 1990. Significant advances in understanding the physical and chemical features of the synthesis have been made. The main parameters of the hydrothermal synthesis are initial pH of the precursor solution, duration, and temperature which define the process kinetics and the properties of the products. The energy conserving hydrothermal conditions favor the crystallization process of high purity powders with few point defects and allow the recovery of chemicals used in the process. From a technological and commercial viewpoint these aspects which are associated with low energy consumption superimpose over similar solvothermal synthesis, due to the absence of a non-aqueous solvent is to assist the chemical reactions. Thus the hydrothermal synthesis represents an environmentally friendly option for the metal oxide synthesis both in powder and film form [3,4].

In a metal oxide hydrothermal synthesis the solution is composed of metal cation precursor, ionic strength controller and water used as a solvent. Substrate is added to the system desired to prepare nanostructured oxide films. Synthesis is carried out under subcritical water conditions in an autoclave reactor by generating an autogenous pressure and changing the physical and chemical water properties. Due to the water viscosity and the high ionic strength hydrolysis reactions are favored without catalyst. This effect is closer to the critical point of water.

Complexity involved in such equilibria contains many inorganic compounds which have their solubility in aqueous media which was calculated by thermodynamic models such as the Helgeson Kirkham Flowers (HKF) model and other researchers have already reviewed to obtain more accurate calculations. By considering that the oxide surface in aqueous media follows the bronsted lowry theory which follows a net charge density is always present when the solution of pH is away from the point of zero charge and the interfacial tension is reduced. This reduction also takes place by controlling the pH and by increasing the ionic strength kinetically favoring the precipitation of the less thermodynamically stable allotropic and high soluble phase. As in some cases sintering steps may not be necessary since an intermediate or the preferable metal oxide phase can be obtained from hydrothermal conditions. Crystallized product formation drives the nucleation rate at the particle growth and the aging processes in the dissolution recrystallization regime which governs the synthesis. Therefore, it is evident that nanoparticles morphology, size distribution, and crystallographic phase direction in powder and films can be delineated by controlling the parameters [5].

The main disadvantages of this method are the very high in cost of the equipment and inability to monitor the crystal growth during the process. To avoid the usage of complex hydrothermal reactors is to decrease energy consumption which is an interesting modification from the typical hydrothermal synthesis by involving at low temperatures and low pressures was developed. This synthesis was known as purpose built materials which was based on the idea of monitoring thermodynamics and kinetics of nucleation and growth by controlling the interfacial tension. Such type of control allows the ability to separate the nucleation and the growth stage which can generates monodisperse nanoparticles with narrow size distribution. Precipitation occurs far from the metal oxide in the presence of charged surface sites of the interfacial tension of the system.

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During the hydrothermal procedure thermodynamics, kinetics of nucleation and growth processes plays an essential role in nanoparticle design. The last step is important step in designing hematite nano rod arrays which corresponds to the thermal treatment. At the end of the hydrothermal synthesis a β-FeOOH layer deposited on the substrate obtained.

REFERENCES

1. Feng S, Xu R. New materials in hydrothermal synthesis. Acc Chem Res. 2001;34(3):239-247.
2. Morey GW. Hydrothermal synthesis. J Am Ceram Soc. 1953;36(9): 279-285.
3. Adhikari S, Sarkar D. Hydrothermal synthesis and electrochromism of WO3 nanocuboids. RSC Adv. 2014;4(39):20145-20245.
4. Yang S, Zavalij PY, Whittingham MS. Hydrothermal synthesis of lithium iron phosphate cathodes. Electrochem Commun. 2001;3(9):508.
5. Komarneni S, Roy R, Li QH. Microwave-hydrothermal synthesis of ceramic powders. Mater Res Bull. 1992;27(12):1393-1405.