International Advance Journal of Engineering, Science and Management (IAJESM)
Multidisciplinary, Indexed, Double Blind, Open Access, Peer-Reviewed, Refereed-International Journal.
SJIF Impact Factor =7.938, July-December 2024, Submitted in September 2024, ISSN -2393-8048

Synthesis of Nanotechnology with Nanostructured Materials

Mamatha K, Research Scholar, Arunodaya University, Mamatha.K1984@gmail.com
Dr. Prince Bansal, Supervisor, Arunodaya University

Introduction

Nanotechnology literally means any technology on a nanoscale that has applications in the real world. Nanotechnology encompasses the production and application of physical, chemical, and biological systems at scales ranging from individual atoms or molecules to submicron dimensions, as well as the integration of the resulting nanostructures into larger systems. Nanotechnology is likely to have a profound impact on our economy and society in the early 21st century, comparable to that of semiconductor technology, information technology, or cellular and molecular biology. Science and technology research in nanotechnology promises breakthroughs in areas such as materials and manufacturing, nano electronics, medicine and healthcare, energy, biotechnology, information technology, and national security. It is widely felt that nanotechnology will be the next industrial revolution.

In recent years, materials with porous architecture and high surface area are being developed for numerous potential applications in nanotechnology. Particular areas of interest include catalysis and separation science . The development and use of such promising materials is also an important factor in solving economic problems, which include the shortage of natural resources. Since the discovery of the ordered mesoporous silica a large number of porous materials have been made using surfactants as template . However, most of these materials are unstable on removal of the surfactant and the porous skeleton collapse easily when heated above 400 º C. It is understood that the collapse of mesostructure in mesoporous materials might be related to the structural rearrangement due to crystallization after removal of organic templates during calcination. Therefore, it is highly desirable to develop new methods of syntheses. In addition, the thermo stability, i.e. the ability of maintaining porous structure at high temperatures is a key to both fabrication of ordered porous material and its practical applications .

- **Combustion synthesis**

Among the various methods of preparation of nanomaterials, combustion synthesis (CS) [37] has emerged as an important technique for the synthesis and processing of advanced ceramics (structural and functional), catalysts, composites, alloys, intermetallies and nanomaterials. In CS, the exothermicity of the redox (reduction-oxidation or useful materials]. Depending upon the nature of reactants: elements or compounds (solid, liquid or gas); and the exothermicity (adiabatic temperature), CS is described as; self-propagating high temperature synthesis (SHS); low-temperature combustion synthesis (LCS), solution combustion synthesis (SCS), gel-combustion, sol-gel combustion, emulsion combustion, volume combustion (thermal explosion), etc.

Solution combustion

The solution combustion (SC) method of preparing oxide materials is a fairly recent development compared to SSC or SHS techniques described above. Today, SC is being used all over the world to prepare oxide materials for a variety of applications. During the short span (15 years) of SC synthesis histories, hundreds of papers on SC of oxides have been published.

X-Ray diffraction

Shows the phase formation of solution combustion derived as made MgO, CaO and ZnO powders. As formed powders show diffraction peaks corresponding to impurities free nanocrystalline cubic phase of MgO, lime-CaO and hexagonal phase of ZnO, which are in good agreement with the literature data.

The particle sizes of th powders are estimated from the full width at half-maximum (FWHM) of the diffraction peaks from the line broadening Scherrer's formula. It is observed that the average particle size of the powders are in the range of 12-23 nm, 35-37 nm and 12-30 nm, for MgO, CaO and , ZnO, respectively.

Surface area measurements

Nitrogen adsorption measurements were conducted on as made MgO, CaO and ZnO,

powders and yielded an isotherms from which a BET surface area 107 m^2/g, 18 m^2/g and 18. m^2/g, could be calculated. The average pore diameter obtained from desorption is found to be 7.8 nm, 5.2 nm and 6.1 nm. shows the nitrogen sorption isotherms and corresponding pore size distribution of the as prepared MgO, CaO and ZnO samples. The isotherms of MgO exhibit type IV characteristics. The isotherms of CaO and ZnO show type III characteristics . The large surface area of MgO powder is due to porous nature of the powder and uniform distribution of nanosized particles which are agglomerated as observed in SEM image and the same may be supported by Scherrer's formula of XRD

Scanning electron microscope

The SEM image shows that the as formed powder of MgO is agglomerated and highly porous having pore diameters in the range 1-11 nm and an average pore diameter is well fitted with the porosity measurement. show that the as formed powders CaO and ZnO are cluster of tiny particles having diameters in the range 6-7 nm and 10-30 nm respectively.

Finger print Analysis

Fingerprints are considered to be the foremost important sort of physical evidence of private identification during crime scenes. Fingerprint detection techniques has been significantly improved over few past decades. Various methods like optical, physical and chemical methods are available for the detection and enhancement of the latent finger marks. Among the varied strategies followed for visualization of latent fingerprints, 'Powder Dusting' may be an extensively used technique for its simple application and its simplicity in handling. So a typical powder dusting method was adopted for the development of LFPs and it's shown in Fig.3.5. Before fingerprint deposition, donors cleaned their hands with detergent and dried them with towel. Then, they rubbed their fingers from the oily parts of the body, just like the retro auricular, forehead and nose regions, to make sure a deposition of a sebaceous fingerprint and deposited their prints by contact with the varied substrates for 1–2 seconds with minimal pressure. The collected fingerprints were stored during a covered box under ambient conditions for further use.

Conclusion

A novel combustion synthesis method has been developed to prepare nanocrystalline metal oxides such as MgO, CaO and ZnO powders. Utilizing of glycine acting as fuel and metal nitrate acting as the duel roles of metal source and oxidant.

When comparing with other methods, it is a simple, quick, and inexpensive method involving a single-step reaction. The crystalline structure of as-synthesized powders becomes more defined as =1.0 increases in case of MgO, ZnO and CaO .

It has been demonstrated that nanocrystalline metal oxides especially MgO, CaO, and ZnO have unparalleled sorption properties for polar organics/ inorganics and other chemical species.

The unique morphological features (crystal shapes), pore diameter and structures, polar nature of the surfaces and high surface areas are believed to account for these unusual sorption properties. The sorption properties are depends on specific application.

The powder density method has been used to visualize the latent finger print on porous, non-porous, and semi-porous surfaces. Results clearly indicates that, the nano powder are quite use full for forensic applications.

References

1. C.T. Kresge, M.E. Leonowicz, W.J. Roth, J.C. Vartuli, J.S. Beck,Nature 359, 710 (1992).
2. H. Yang, N. Coombs, I. Sokolov, G.A. Ozin, Nature 381, 589(1996).
3. N.K. Raman, M.T. Anderson, C.J. Brinker, Chem. Mater. 8, 1682(1996).
4. D. Zhao, F. Feng, Q. Quo, N. Melosh, G.H. Fredrickson, B.F.Chmelka, G.D. Stucky, Science 279, 548 (1999).
5. P. Yang, D. Zhao, D.I. Margolese, B.F. Bates, G.D. Stucky, Nature 396, 152(1998).
6. J.Y. Ying, C.P. Mehnert, M.S. Wong, Angew. Chem. Int. Ed. Eng, 56(1999).
7. G.T. Chandrappa, N. Stenuou and J. Livage: Macroporous crystalline vanadium oxide foam. Nature, 416, 702 (2002).