SYNTHESIS AND CHARACTERIZATION OF ALUMINIUM OXIDE BASED & BINARY METAL OXIDE NANO COMPOSITES : A REVIEW OF LITERATURE

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ABSTRACT

Literature review is an account of what has been published in connection with this research. The main purpose is to gain knowledge and ideas based on the previous establishment and get to know what their strength and weakness are in order to further enhance and upgrade the integration. It identifies the work done by other authors. This paper describes explores various studies that are related with Synthesis And Characterization Of Aluminium Oxide Based & Binary Metal Oxide Nanocomposites

Keywords : Al2O3, CuO, MgO, CeO2 etc

Introduction

A literature review is a text written by someone to consider the critical points of current knowledge including substantive findings as well as theoretical and methodological contributions to a particular topic. Generally, a researcher conducts and surveys the related literature in order to review the present status of a particular research topic. From the survey of literature, a researcher is able to know the quantum of work already done on his research topic so far and also helps to know the areas which are not touched, or yet to be undertaken. The overview of literature at the national or an international level is to be researched with the help of research reports, articles, books and other materials. The major benefits of literature reviews are: firstly, helps the researcher in avoiding duplication of efforts on the same research topic. Secondly, helps the researcher in adopting methodologies used successfully by other researchers, writers and policy makers. Thirdly, suggests new approaches in planning, organizing the investigation of research topic. Fourthly, helps to narrow down the research problem more clearly and lastly, assists investigators to develop firm understandings of theoretical implications of proposed inquiries.

Review Of Literature

S. Said, S. Mikhail, M. Riad (Feb 2020):reviewed different methods of preparation, recovery functionallization and applications of alumina nanoparticles. The applications of alumina nanoparticles in various fields such as membrane, catalysts support and adsorption were also reviewed.

MeganeMuschi et al (2019): The researcher studied the promising prospects of graphene oxide coupled with inorganic-organic hybrid materials, in various structures in reference to metal –organic frameworks and found that the nature of the interactions between the carbon based material and the hybrid were strongly depend on the synthetic method.

SR Smith, R Rafati, AS Haddad, A Cooper et al. (2018) : demonstrated that nano-enhanced drilling fluids have an improved thermal stability at heightened temperatures and can withstand the harsh conditions in advanced drilling operations while they impose a lower environmental impact and capital costs.

Harish Kumar K etal.(2018): summarized the properties ,characteristics .advantages and disadvantages of metallic nanoparticles. Preparation and modification of metallic nanoparticles with various chemical functional groups allow them to bind with antibodies, ligands and drugs.

Vijaya Pandurang Dhawale, VaideiBalraj Khobragade, et..al (2018):investigated decolourisation by 30 mg dose of aluminium oxide nanoparticles and found that aluminium oxide nanoparticles offer new dimension towards reliable and economically affordable water treatment of coloured industrial effluents.

Naveen Kumar and ShrinivasaMayyaet al.(2018): The researcher studied about the various synthesizing methods , preparation of composites, fabrication and gas sensing utilization of graphene-based nanocomposite and discussed the utilization of graphene -based nanocomposites as chemical detection which is beneficial for observing the harmfulness, explosive nature and inflammability of gases. Diversified metal oxides like tin oxide, indium oxide as soon as The Authors combined with graphene based material showed enormous potentiality for detection of amount of harmful gas.

Shreya Kaul et al.(2018): The researcher highlighted the various novel carriers used for the delivery of

cosmeceuticals, their aspects, marketed formulations, toxicity and regulations of nanocosmeceuticals. The present work tailored the impact of increased use of nanoparticles in cosmeceuticals as there are possibilities of nanoparticles to penetrate through skin and cause health hazards. Nano-cosmeceuticals used for nails, lip care skin, for hyper- pigmentation, dandruff and hair damage was found to be very prevalent.

Novel nanocarriers like niosomes, liposomes, nanoemulsions have advantages of enhanced skin penetration, higher stability and high entrapment efficiency.

V.N. Kalpana and V. Devi Rajeshwari (2018): The work emphasis to consider various green synthesis methods to provide the evidence of ZnO NP role to several applications, toxic effect and biomedical applications. Because of the various properties like UV filter, antifungal, photo-chemical, and antimicrobial activities the zinc oxide nanoparticles were found to achieved a great interest. The researcher also made comparative study of green route of synthesis and the physical and chemical route of synthesis as green synthesis was found to be environmentally safe and eco friendly when compared to physical and chemical means of synthesis.

MarziyehAjdary et al .(2018): Health concerns of various Nanoparticles were discussed by the authors and diversity of Nanoparticles and their physico-chemical properties including particle size, shape,surface area, dispensability and protein corona effects were considered as key factors that have a crucial impact on their safe or toxicological behaviors. The Authors aimed to study on toxic effects of nanoparticles toidentify the target and mechanism of their side effects,accumulation, degradation and elimination in both in vitro and in vitro models as nanoparticles enter the body through inhalation ,skin and digestive routes.

Gaurav Sharma et al. (2016): Phytoassisted synthesis of magnesium oxide nanoparticles with an aqueous extract of S.chirayaita was done. Magnesium oxide nanoparticles synthesized by this method were <20 nm in size. The synthesized nanoparticles were characterized by SEM, TEM, XRD and UV- VISIBLE spectroscopy. MgO nanoparticles showed crystalline nature with face centred cubic geometry. The results of this study showed that the pathogenic strains tested were susceptible to magnesium oxide nanoparticles, which confirmed their potential effectiveness against another bacterial strains.

Lei Li et al.(2015): The Authors investigated the gas sensing properties of SnO_2-SnO composite material with a p-n heterojunction structure through hydrothermal process for the detection of NO_2 gas .Properties of the nanocomposite and structural analysis were employed by electron microscopy and XRD. HRTEM characteristics showed that the p-n hetero- junctions were formed with small n-type SnO_2 nanocrystal dispersed on the surface of large p type SnO_2 crystals. The Authors observed that the sensing performance was much higher than that of pure tin oxide nanoparticles.

Xiulin Fan et al. (2014): The Authors prepared a hierarchalSnO_2 composite with carbon coated tin oxide nanoparticles uniformly dispersed in the micro- sized porous carbon matrix using a facile and scalable solution – evaporation- calcination method. The Authors exhibit a capacity of 640mAh per gram at 500mA per gram in the initial 150 cycles and then increases to 720Ma h per gram and maintains this capacity for 420 cycles. This method proved to have an excellent electrochemical performance which makes the SnO2@C porous composite a promosing anode material for LIBs.

Ashok K Singh et al.(2013): The Authors prepared SnO2 nanoparticles using microwave method. Synthesized nanoparticles were characterized by XRD, SEM, EDS to find their structure ,morphology and elemental composition. The Authors observed the synthesized nanoparticles were of spherical morphology having crystallite size of 35.42 nm . Synthesized nanoparticles were used for photodegradation of methylene blue (MB) dye under UV light.The nanoparticles were found to have photodegradation efficiency and apparent rate constant of 55.97% and $2.149*10^{-2}$ respectively. **Ganesh E Patil et.al. (2012):**The Authors synthesized SnO_2 nanoparticles by hydrothermal method at low temperature using hydrazine hydrate as a mediator. The selected area electron diffraction patterns showed continous ring paterns revealed their crystalline nature. The structural ,morphological, and optical properties of SnO2 sample were investigated. The surface morphology was investigated by FESEM. The optical band gap of the SnO2 film was found to be 3.6eV given by diffused reflectance spectroscopy.

A.H. Wani and M.A.Shah (2012): The antifungal activity of zinc oxide and magnesium oxide nanoparticles prepared by bio safe mrthod was evaluated for Alternaria alternate, Fusarium oxysporum, Rhyiopusstolonifer and Mucor plumbeus. The highest inhibition in the germination of all the test fungi was observed at higher concentration followed by lower concentration of nanoparticles. MgO nanoparticles at highest concentration was found to be most effective in reducing the spore germination followed by Zinc nanoparticles at same concentration.

Parmod Kumar et al .(2012): The Authors prepared Zn_{1-x} Mg_xO where x lies between 0 and 0.2 by sol-gel method. XRD results showed the formation of pure ZnO phase below x=0.1 and above indicating the phase segregation of MgO for x>0.10. From spectroscopic results optical band gap was found to be increased that may be attributed to the defect states as observed through photoluminescence and Raman spectra.

Q.J. Wang et al. (2012): The Authors studied the magnetic mechanism in undoped ZnO and doped ZnO with non magnetic elementsX(X=Li,Mg and Al). In undoped ZnO it was found that Zn vacancy was spin polarized with magnetic moment of 1.45which mainly comes from the O atoms nearest to the Zn vacancy. and in ZnO doped with non magnetic elements the magnetism was attributed to the prescence of Zn vacancies. In X doped ZnO systems it stabilizes the ferromagnetism.

S Tewari and Bhattacharjee(2011): The Authors studied the electrical and structural properties of Al doped zinc oxide thin films prepared by the chemical spray pyrolysis technique using $Zn(CH_3COO)_2$ as precursor solution. The Authors prepared aluminium doped thin films of zinc oxide by using $AlCl_3$ as doping solution for aluminium. Dopant concentration was varied between 0 to 1.5%and their structural characterization were performed with XRD .Pollycrystalline nature with hexagonal wurtzite structure were obtained with size varying between 100.7 and 268.6 nm. The Authors found that the conductivity of the ZnO film improved upto 1% of Al doping concentration but beyond that it decreased with aluminium doping. The Authors observed a blue shift in the absorbtionedge,improved emission in the UV region.

Amitava Mukherjee, Mohammed Sadiq I., Prathna T.C., N. Chandrasekaran (2011):investigated the use of nanoparticles as a potential alternatives as antimicrobial agents because the microorganisms are unable to develop resistance against nanoparticles. Notable antimicrobial properties of aluminium oxide nanoparticles are enabling their application in the clinical sector. However detailed studies regarding the interaction of alumina nanoparticles with cells need to be ascertained before extensive use in medical application.

Thomas Hanemann et al. (2010): The Authors discussed about the special features of inorganic nanoparticles, the most important synthesis methods for ceramic nanoparticles and nanocomposites, nanoparticle surface modification, composite formation including drawbacks. The Authors considered the classical nanoparticle properties as dielectric, magnetic,optical properties and their typical existing and potential applications and The Authors tried to focus on innovative applications like in energy storage systems.

Michael F. Ashby(2006): The Authors discussed about the mechanical properties ,thermal properties and optical properties of the nano-materials While discussing the properties melting point of a material was found to be of great importance as the surface to volume ratio in bulk systems is small so surface effects can be disregarded. While in case of nanoscale solids,for which the surface to volume ratio may be regarded as containing surface phases in addition to the volume phases. The Authors discussed about the quantum confinement that occurs in nanomaterials. At last various methods for synthesisizing nanomaterials were discussed for 0-D,1-D,2-D nanomaterials. Inert gas condensation,sono chemical processing, molecular self assembly, Sol gel deposition, Electrodeposition,physicalvapour deposition, chemical vapour deposition were discussed.Characterization of various nanomaterials were also concerned.

Conclusion

Nanotechnology is a field of applied science focused on the design,synthesis and characterization and applications of materials and devices on the nanoscale.Nanomaterials can be added to other materials, thereby lending some of their unique properties to the overall performance of the composite object.Nanotechnology involves research and technology development at the atomic, molecular or macromolecular levels in the range of approximately 1-100 nanometers to provide fundamental perceptive of phenomena and materials at nanoscale. The nanometer scale is about a billionth of a metre[30]. Basically, nanotechnology is used to create structures, devices and systems that have novel properties and functions because of their minute size.

References

1. Singh, A. K., & Nakate, U. T. (2013). Advances in Nanoparticles. *Journal of Nanoscience & Nanotechnology*, 2(66-7).
2. Muschi, M., & Serre, C. (2019). Progress and challenges of graphene oxide/metal-organic composites. *Coordination Chemistry Reviews*, 262, 272.
3. Ashby, M. F., Ferreira, P. J., & Schodek, D. L. (2006). Nanomaterials, Nanotechnologies, and Design: An Introduction for Engineers. *Elsevier*.
4. Kumar, N. J. R., Maiyya, S., Savitha, M. B., & Prasad, P. (2018). Graphene-based Metal oxide Nanocomposites for Gas Sensing Applications. *IAJEML*, 2(2).
5. Zhang, L., & Wang, H. (2020). Synthesis and application of metal oxide nanomaterials for environmental remediation. *Environmental Science & Technology*, 54(5), 3215-3226.
6. Chen, W., & Zhang, Y. (2019). Advances in graphene oxide-based nanocomposites for energy storage and conversion applications. *Journal of Materials Chemistry A*, 7(32), 18509-18525.

7. Wang, X., & Zhang, G. (2018). Recent advances in nanomaterials for gas sensors: A review. *Journal of Nanomaterials*, 2018, 1-15.
8. Kamat, P. V. (2007). Photophysical, photochemical and photocatalytic aspects of nanomaterials. *Journal of Nanoscience and Nanotechnology*, 7(9), 3348-3372.
9. Bhanushali, S., & Wang, Y. (2016). Graphene and metal oxide composites for energy storage applications. *Nano Energy*, 28, 91-104.
10. He, X., & Zhang, Z. (2021). Recent advances in metal oxide nanomaterials for catalysis applications. *Nature Reviews Chemistry*, 5(4), 285-305.
11. Cho, W., & Yoon, S. (2015). The synthesis of metal oxide nanocomposites and their applications. *Journal of Materials Science*, 50(8), 3771-3783.
12. Li, X., & Ma, Z. (2019). Graphene oxide-based composites for environmental applications. *Environmental Science and Pollution Research*, 26(5), 4117-4127.
13. Liu, Y., & Zhang, S. (2017). Synthesis and applications of metal oxide nanoparticles. *Materials Science and Engineering: R: Reports*, 117, 1-25.
14. Huang, Y., & Cheng, X. (2018). Metal oxide/graphene oxide composites: Synthesis, characterization, and applications. *Journal of Materials Chemistry A*, 6(35), 17292-17307.
15. Miao, J., & Li, Y. (2020). Metal oxide/graphene composites for environmental applications: A review. *Environmental Pollution*, 263, 114312.
16. Liang, Y., & Zhang, L. (2019). Metal oxide composites for energy storage and conversion: A review. *Nano Energy*, 59, 190-206.
17. Kundu, S., & Ghosh, S. K. (2018). Synthesis and applications of metal oxide-based nanomaterials for gas sensing. *Sensors and Actuators B: Chemical*, 268, 1-16.
18. Xu, Y., & Guo, H. (2017). Metal oxide nanomaterials for energy storage devices. *Journal of Materials Chemistry A*, 5(10), 4557-4576.
19. Zhang, J., & Wang, L. (2020). Advances in metal oxide/graphene nanocomposites for high-performance gas sensors. *Advanced Functional Materials*, 30(1), 1-19.
20. Lee, J. H., & Kim, H. S. (2016). Graphene oxide-based nanocomposites: Synthesis, properties, and applications. *Nano Today*, 11(2), 185-201.