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SPECIFIC USES OF NANOMATERIAL AND THEIR ENVIRONMENTAL EFFECTS

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ABSTRACT

Nanotechnology has been a major field of science in the world today. The present analysis includes nanomaterial classification and numerous applications including catalysis, water treatment, sensors, energy storage and nanomedicine, as well as their positive and negative environmental impacts. Increased attention needs to be placed on the new nanomaterials because awareness production of these nanoparticles is still in its infancy. Nanoparticles are ultra-small particles with extraordinary properties, but they do have harmful properties in certain nanoparticles and nanomaterials.That is why we need to continue researching them and their potentially harmful effects

INTRODUCTION

Nanotechnology is an interdisciplinary research that helps one to create modern, fascinating, and useful materials. They are nanomaterials consisting of nanoparticles. Nanoparticles are ultra-small particles with exceptional properties that can guide drugs straight to where they are required by the human body, they can make materials stronger and they can more effectively transform solar energy. Nanoparticles possess different properties and behave differently from the traditional, larger material building blocks.At a science point of view, these fascinating new effects are not so much the product of the fact that nanoparticles are tiny but derive from the assumption that, for basic physical purposes, a particle composed of a very limited number of molecules reacts and interacts differently with its surroundings. Thanks to their customizable physicochemical characteristics such as melting point, wettability, electrical and thermal conductivity, catalytic operation, light absorption and scattering, nanoparticles and nanomaterials have gained popularity in technical advancements, resulting in improved efficiency over their broad counterparts.Properties (electrical conductivity, color, chemical reactivity, elasticity, etc.) may be controlled by regulating the form, thickness, and internal order of the nanostructures[1, 2]. China has made tremendous strides lately, and already has the most rising publications on nanotechnology and associated industrialization. In terms of average citations per articles and publications in high-impact journals, China is often left behind by American nanotechnology, initiatives are less coordinated in the European Union[3].

NANOPARTICLES AND NANOMATERIALS

In general, nanomaterials are generally listed under development as I carbon-based, (ii) metal-based, (iii) dendrimers, and (iv) composites[6]. Carbon based NMs generally contain carbon, and can be found in morphologies such as hollow tubes, ellipsoids or spheresMetal-based NMs are copper-based compounds that we generally find of metal bases to be quantium spots, nanogold, nanosilver and oxides. One proof of this is titanium dioxide. The biomedical and pharmacy companies depend on these. Dendrimers are branched chains that form polymers, and whose surface ends of the chain are ideal as instruments for chemical manipulation. Dendrimers can be combined to create hollow cavities, or used as a catalyst.endrimers are a half step between molecular and polymer chemistry[7]. Dendrimers was distributed via biomedicine, with uses such as anticancer medications, pain relief and prompt releaseMedications include transdermal patches or gene therapy. Composites are a mixture of nanoparticles and other components. Nanoparticles, such as nanosized clays, are now being applied to items ranging from car parts to packaging materials, to enhance mechanical , thermal, barrier and flame retardant properties[8].While Ag, zinc oxide (ZnO), copper oxide (CuO), cerium dioxide (CeO2), titanium dioxide (TiO2), iron oxide (FeO), fullerenes, carbon nanotubes (CNTs), and a limited number of others are still the most commonly used and researched nanomaterials (NMs), several newer NMs have been developed in the last years. Broad groups of materials including nanocomposites and nanohybrids have been of greatest importance and growth. Nanocomposites are bound or encapsulated with NMsHere we should concentrate mainly on carbon and metal related nanomaterials and their applications

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APPLICATION OF NANOMATERIAL

LITHIUM ION BATTERIES(LIBs)

Thanks to the growing applications of portable mobile devices and transportations, lithium-ion batteries are considered as the most exciting rechargeable energy storage technology. Fe3O4 nanomaterials have been extensively studied as LIB anode materials for their strong theoretical potential (900–1000 mA·h·g−1), low expense, environmental benignity, and unique properties to obtain high power and energy density[59, 61].Single crystalline mesoporous Fe3O4 nanorod, for example, exhibits a strong reversible power of 843.5 mA·h·g−1 at 0.1 C after the 50th cycle; in addition, the nanorods have superior electron transport capabilities, rendering them extremely desirable for future use as LIB anode materials[46]. Nevertheless, the large nanomaterial surface area may induce secondary reactions such as electrolyte decomposition between electrode and electrolyte and shape dense solid electrolyte interphase (SEI) films on the surface of the electrode[62]. Fortunately, surface modifications were found to be able to partly solve these problems[23].Carbon-coated Fe3O4 nanospindles can improve the electronic conductivity of electrodes leading to thin and standardised SEI films but also stabilise the obtained SEI films; consequently, the Fe3O4-C composites are excellent anode materials for highly efficient LIBs with high reversible power ,high speed flexibility and improved cycling efficiency. Li group reported monodisperse core-shell spheres, chains and rings of Fe3O4 / C with adjustable magnetic properties based on structural evolution from excentric core-shell nanoparticles of Fe2O3 / poly(acrylic acid)[63].The chains and rings show higher reversible efficiency and greater rotating flexibility compared with the core-shell spheres Fe3O4 / C. Some other forms of shaping Fe3O4-C composites were used [30, 64, 65]. For example, porous carbons or mixing graphene layers are impregnated with the precursor Fe3O4; meanwhile, Fe3O4 NPs and carbon are produced from a precursor with high surface area and porosity.

CATALYSIS

Catalysis is one of the leading nanoparticular techniques. For several years , different elements and components such as carbon, iron, titanium dioxide, clays and silica have also been used as catalysts in the nanoscale. Thanks to its strong operation, selectivity and efficiency nanocatalysis has been an evolving area of research in recent years. The tiny metal nanoparticles in a spectrum of 1–10 nm show exceptional catalytic efficiency, even greater than the metal complexes in question.Nanocatalysts' strong activity is due to many significant factors like the large surface-to - volume ratio, the physical surface impact, the electrical impact and the quantum scale effect. Metal nanoparticles suspended in solution are commonly used as efficient heterogeneous catalysts because of the advantages ofSimplified plastic insulation and fast recovery, and superb recyclability, make metal nanocatalysts environmentally friendly. Nanocatalysts' catalytic performance (e.g., conversion and selectivity) is drastically affected by the size of metal nanoparticles[15]. When utilising catalytic reagents, the temperature of a transition may be reduced, reagent-based waste decreased and a reaction selectivity increased that theoretically prevents unnecessary side reactions contributing to green technologies.Throughout the absence of a catalyst, it will not be possible to use a range of items, i.e. drugs, fine chemicals, polymers, fibres, oils , paints, lubricants, and many other value-added goods which are important for humans. Therefore processing processes can be rendered more competitive, ecological and safe by utilising catalysts. Carbon nanotubes may be used in the field of chemistry as catalysts for partial oxidation of fuel cells, organic ammonia and methane, and commonly used in photocatalytic reactions.

WASTEWATER TREATMENT

Treatment of wastewater has drawn significant interest in recent years, because safe water is important to humans and because of a number of main industries[66]. Nanoscience technology provides a new and efficient route for handling wastewater. Several researchers utilised nanomaterials from Fe3O4 to handle heavy metal ions, and chemical waste. Nanostructured Fe3O4 microspheres (NFMSs) with a wide specific surface area (135.9 m2·g−1) will extract toxic Cr6 + from polluted water, and it is observed that 1 g NFMS extracts 43.48 mg Cr6 + ions at room temperature[67].Fe3O4 nanomaterials were also widely used as catalysts to eliminate organic pollutions from wastewater, such as xylenol black, phenol, and aniline[68–70].

SENSORS

Developing a wide variety of nanomaterials has paved the way for their applicability in the production of high-performance electrochemical sensing systems for medical diagnostics, climate, and food protection. The analysis of [26] shows that various nanomaterials were synthesised for the electrochemical determination of certain specific additives and pollutants, including hydrazine (N2H4), malachite green (MG), bisphenol A (BPA), ascorbic acid (AA), caffeine, caffeic acid (CA), sulfite (SO32−) and nitrite (NO2−), which are commonly contained in food and beverages.The area of biosensors has been profoundly influenced by nanotechnology, particularly through their high sensitivity and selectivity, as well as the miniaturisation of sensors. Throughout this case, fluorescent nanomaterials and nanostructures were used for the production of modern nanostructured biosensors for detecting glucose. The electrochemical method for sensing glucose in the form of a blood glucose metre is widely used among patients with diabetes[27].Carbon nanotubes, such as gas sensors, tiny molecular sensors, electrochemical detectors, and chromatographic applications may also be used to establish molecular detection. Modifying the macroelectrode with nanoparticles and other nanomaterials decreases the detection maximum and increases the degree of measuring sensitivity and selectivity[28].

NANOMEDICINE

The properties of silver nanoparticles such as broad-acting and potent antibacterial activity are widely investigated. A wide range of nanosilver applications has emerged in consumer products ranging from disinfecting medical devices and home appliances to water treatments, as well as in nanomedicine. Research interest in biocompatible gold nanoparticles has been highly increased in recent years for potential applications in nanomedicine due to their fascinating size dependent chemical SSRG International Journal of Materials Science and Engineering (IJMSE)-Part 5 Issue 1 January-April 2019 ISSN: 2394 – 8884 http:/www.internationaljournalssrg.org Page 4 electrical and optical properties. Many of the related uses, such as phototherapy, drug delivery, photodynamic therapy, gene therapy, biolabeling, biosensing, etc., are revolutionizing the area of biomedicine, which is gaining immense research attention[33].AuNPs are non-cytototoxic, with additional advantages from a wide surface area that makes their surface available for alteration by attacking molecules, rendering them useful for different medicinal applications relative to other nanoparticles. Treated drug delivery is the most efficient treatment, as even the infected cells or sections can be treated. That minimizes drug side effects. The drugs can be administered directly to infected cells without any damage to healthy cells, which is useful to treat cancer.Quantum points are easily used [34] for guided distribution, Fe3O4[35]; [36] and ZnO [37]. For bio-imaging biosensing and labeling, gold nanoparticles can be used. Golden nanoparticles were used in cellular or molecular imaging for several years as contrast agents[38]. Ma and colleagues have developed a novel colorimetric-detection sensor for the color shift effect on Salmonella typhimurium from gold nanoparticles[39]. In biosensing applications gold nanoparticles are commonly used these days[40; 41].

IMPACT OF NANOMATERIALS ON THE ENVIRONMENT

The through production and use of NMs in various manufacturing and building processes as well as in medical and consumer goods leads to increasing human and environmental exposure. Nanomaterials from many sources and exposure pathways, including food intake, direct contact in the dermal system by consumption products and airborne nanomaterial inhalation, are found in humans [46]. Nanoparticles have gradually been more and more exposed to nanomaterials in our lives or the customer's outputs. The climate, therefore, may be dependent on the biological , physical or chemical properties of these objects. Therefore, their transformation and bioavailability during their propagation in the surface of nanoparticles and other physical-chemical properties can greatly impact. However, the estimation of possible contamination impacts involving toxicity and nanoparticles within the atmosphere still has no robust structures.

NEGATIVE IMPACTS ON ENVIRONMENT

New nanomaterials can react in a new and unpredictable manner with biomolecules, cells, organs and species. Humans and the atmosphere can also have significant adverse effects on nanomaterials[66]. Other aspects in nanotechnology that have been needed are public and regulatory acceptations. This works primarily on the health and safety and environmental effects of the goods and products.Some materials are wonderful for a certain task, but because of their environmental impact they are not acceptable[67]. Particulate content, compounds or aggregation of these nanoparticles is impaired by toxicological activity. At the moment, other literature suggested that marine species are adversely affected by the production of nanoparticles in watery or aqueous environments [68].Nanomaterials have adverse impacts on biological processes and the environment caused by nanoparticles, including chemical hazards on edible plant species after therapy with high concentrations of nanosilver, and in

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some instances free nanomaterials in living material contributing to DNA damage. The biological effects of Ag2S nanoparticles have recently been studied by scientists. As nanoparticles were used to upregulate genes, the growth of plants was reduced.Since the bulk of nano pharmaceutical ag2s is collected on the leaves of the plant studied, this trend improved the probability of trophic transport through the food chain. In addition, genotoxic effects (low dose 0.25 mM) were found to affect DNA (higher concentration) on plants, such as Allium cepa and Nicotiana tabacum, as a consequence of transfer from such nanoparticles as TiO2[70]. There were also observed small to moderate effects on marine life of the presence of NMs. Nanomaterials that impact specific aquatic species and creatures (e.g. fish and daphnia), according the to toxicological research [71]. Multiple research findings suggest that silver nanoparticles are toxic to cells as both silver nanoparticles and silver ions exhibit a similar cytotoxicity[72], due to their release of silver ions. Although there is no clear detail on the toxic mechanism, it suggests that nanosilver particles are ionized in cells , leading to ion channels being activated and the cell membrane being permeable to both potassium and sodium, interaction with mitochonde, and the induction of the pathway for apoptosis via reactive oxygen species.

POSITIVE IMPACTS ON ENVIRONMENT

Machinerized nanomaterials released into the atmosphere appear to be considerably stronger in sunlight and UV rays than in other compartments [49]. [49]. The future effects of photochemical nanomaterial modifications are expected to improve this exposure. The environmental consequences are positive and detrimentalFor planes, nanomaterials are used to replace traditional composites to help reduce the weight of the aviation and to conserve thousands of tons of fuel[50]. In order to make them stronger and lighter, nanomaterials are often used in wind turbine blades to improve the energy conversion efficiency[51]. Nanomaterials are increasingly used to improve chemicals reactions while reducing emissions and investments in vehicle exhaust systems and petroleum processing systems[52].Nanomaterials have successfully been applied with better efficiency than traditional methods to purify air and water by adsorption, filtration and oxidation methods. A number of Gram-negative and Gram-positive particulates and antibiotic resistant bacterial species are infected by nanosilver particulate matter[53]. A broad variety of growing funguses is effective antifungal agent. NSPs are able to effectively inhibit the development of Candida albicans, Candida parapsilosis, Candida krusei and Trichophyton mentagrophytes.Nanotechnology has received greater interest in recent years in the field of food health. In their architectures and designs, the nanotechnology-based detection systems share the same purpose, that is to identify trace pathogens and other pollutants timely and accurately. In many fields, nanotechnology has been very useful , especially in the agro-food market, where it is predominantly used: primary processing , food engineering, packaging, and food supplements[55]. Nanotechnology has a wide variety of uses in various areas, from nano-sensors to livestock safety tracking (sheep, pigs) [56; 57; 58].Tools in the nanotechnology sector have the ability to improve agricultural productivity by improved plant and animal productivity management and conservation. In contrast to traditional nanofertilizers they have beneficial results. It happens in order to improve their solubility with the use of zinc nanoparticles in Zn fertilizers [63; 62]. De la Rosa et al.[64] find it possible to improve the growth and biomass of alfalfa, tomato and cucumber by using zinc-oxide nanoparticles by foliar sprinkling.Claudia FrancelyCumplido-Nájera and colleagues have shown that copper nanoparticles and potassium silicates have modified the levels of enzymes and non-enzymes that are important for defending tomato plant, and that the resistance of C has been improved. mythiopia. In comparison, bacterial production losses have reduced by 16.1%[65].

CONCLUSION

The study concluded that while new nanomaterials have been developed and further improved, they still have positive and negative impacts on bothISSN: 2394 – 8884 http:/ww.internationaljournalssrg.org page 6 on climate and human beings. SS RGS (International Science and engineering journal of the SSRG) – Volume 5 Issue 1 April-2019 ISSN: 2394 -8884 Therefore, nanomaterials should be viewed to drugs since both desirable and harmful results are well known. Nanomaterials in different fields, such as catalysis, sensing, photovoltaics, electricity, climate and biomedicine have been explored until now. The nanomaterial amount is nevertheless gradually growing in the world. The risks for plants from nanomaterials,The threats to plants , animals and bacteria in nanomaterials have had an unintended impact on our human lives. More attention must be paid to new nanomaterials because the knowledge of these nanoparticles is still in its early stages. Since nanoparticles can be both important in their form, size and composition and possible threats to their work as well as to human safety, thorough research is needed to understand their structure, characteristics and toxicity.

REFERENCES

[1] Martín-Gago, J.A., Casero, E., Briones, C., Serena, P.A., 2009. Nanociencia yNanotecnología. Entre lacienciaficción del presente y la tecnología del futuro. Fundación Española para la Ciencia y la Tecnología FECYT, Madrid.

[2] Serena, P., 2016. Guíaespecífica de trabajosobre ―nanotecnología para la revoluciónurbana: ciudadesinteligentes‖.

[3] Haiyan Dong, YuGao, PatrickJ.Sinko, ZaishengWu, Jianguo Xu, Lee Jia, The nanotechnology race between China and the United States, Nano Today 11, (2016), 7—12. [4] European Commission, 2016. Recommendation on the Definition of a Nanomaterial. http://data.europa.eu/eli/reco/2011/696/oj.

[5] Appenzeller T., The man who dared to think small, Science. 1991 Nov 29;254(5036):1300.

[6] Saleh, T.A., 2016. Nanomaterials for pharmaceuticals determination. Bioenergetics 5, 226. https://doi.org/10.4172/2167-7662.1000226.

[7] Elham Abbasi, SedighehFekri Aval, AbolfazlAkbarzadeh, Morteza Milani, Hamid Tayefi, Nasrabadi, Sang Woo Joo, Younes Hanifehpour, Kazem Nejati-Koshki, and RoghiyehPashaei-Asl, Dendrimers: synthesis, applications, and properties, Nanoscale Res Lett. 2014, 9(1): 247.

[8] Classification of Nanomaterials, The Four Main Types of Intentionally Produced Nanomaterials, 2007, https://www.azonano.com/article.aspx?ArticleID=1872 on date 03.01.2019.

[9] Saleh NB, Aich N, Plazas-Tuttle J, Lead JR, Lowry GV. 2015. Research strategy to determine when novel nanohybrids pose unique environmental risks. Environ Sci Nano 2:11–18.

[10] Wu W, Jiang C, Roy VAL. 2015. Recent progress in magnetic iron oxide–semiconductor composite nanomaterials as promising photocatalysts. Nanoscale 7:38–58. [11] Alshammari Fanar Hamad, Jong-Hun Han, Byung-Chun Kim, Irfan A. Rather, The intertwine of nanotechnology with the food industry, Saudi Journal of Biological Sciences 25 (2018) 27–30.

[12] A. Bratovčić, A. Odobašić, S. Ćatić, I. Šestan, Application of polymer nanocomposite materials in food packaging, Croat. J. Food Sci. Technol. (2015) 7 (2) 86-94.

[13] Rineesh NR, Neelakandan MS, Thomas S (2018) Applications of Silver Nanoparticles for Medicinal Purpose. JSM NanotechnolNanomed 6(1): 1063.

[14] Chen, M., Qin, X., Zeng, G., Biodegradation of carbon nanotubes, graphene and their derivatives, Trends Biotechnol. 35, (2017), 836-846.

[15] Gao Li, RongchaoJin, Catalysis by gold nanoparticles: carbon-carbon coupling reactions, Nanotechnol Rev 2013; 2(5): 529–545.

[16] Santosh Bahadur Singh, Praveen Kumar Tandon, Catalysis: A Brief Review on Nano-Catalyst, Journal of Energy and Chemical Engineering, 2014, 2, 3, pg.106-115.

[17] W.-W. Tang, G.-M. Zeng, J.-L. Gong et al., ―Impact of humic/fulvic acid on the removal of heavy metals fromaqueous solutions using nanomaterials: a review,‖ Science of the Total Environment, vol. 468-469, pp. 1014–1027, 2014.

[18] Yan J., L. Han,W.Gao, S.Xue, andM.Chen, ―Biochar supported nanoscale zerovalent iron composite used as persulfate activator for removing trichloroethylene,‖ Bioresource Technology, vol. 175, pp. 269–274, 2015.

[19] Liu F., Yang J. H., Zuo J. et al., ―Graphene-supported nanoscale zero-valent iron: removal of phosphorus from aqueous solution and mechanistic study,‖ Journal of Environmental Sciences, vol. 26, no. 8, pp. 1751–1762, 2014.

[20] Kalhapure R. S., Sonawane S. J., Sikwal D. R. et al., ―Solid lipid nanoparticles of clotrimazole silver complex: an efficient nano antibacterial against Staphylococcus aureus and MRSA, Colloids and Surfaces B: Biointerfaces, vol. 136, pp. 651–658, 2015.

[21] Haijiao Lu, Jingkang Wang, Marco Stoller, Ting Wang, Ying Bao, Hongxun Hao, An Overview of Nanomaterials for Water and Wastewater Treatment, Advances in Materials Science and Engineering,

Volume 2016, Article ID 4964828, http://dx.doi.org/10.1155/2016/4964828

[22] Zhao, Z.M.; Sun, J.; Xing, S.M.; Liu, D.J.; Zhang, G.J.; Bai, L.J.; Jiang, B.L. Enhanced Raman scattering and photocatalytic activity of TiO2 films with embedded Ag nanoparticles deposited by magnetron sputtering. J. Alloys Compd. 2016, 679, 88–93. [23] Guo, Q.; Zhou, C.Y.; Ma, Z.B.; Ren, Z.F.; Fan, H.J.; Yang, X.M. Elementary photocatalytic chemistry on TiO2 surfaces. Chem. Soc. Rev. 2016, 45, 3701–3730.

[24] Zheng, L.X.; Han, S.C.; Liu, H.; Yu, P.P.; Fang, X.S. Hierarchical MoS2 nanosheet@TiO2 nanotube array composites with enhanced photocatalytic and photocurrent performances. Small 2016, 12, 1527–1536.

[25] A. Bratovcic, Photocatalytic degradation of organic compounds in wastewaters, Technologica acta, ISSN 1840-0426, accepted review paper, 2019.

[26] Venkatesh S. Manikandan, BalRam Adhikari, Aicheng Chen, Nanomaterial based electrochemical sensors for the safety and quality control of food and beverages, Analyst, 19, 2018

[27] Longyi Chen, Eugene Hwang, Jin Zhang, Fluorescent Nanobiosensors for Sensing Glucose, Sensors 2018, 18(5), 1440; doi:10.3390/s18051440

[28] BraininaKh., Stozhko N., Bukharinova M., Vikulova E., Nanomaterials: Electrochemical Properties and Application in Sensors, Physical Sciences Reviews, Vol. 3, 9, 2018, doi: https://doi.org/10.1515/psr-2018-8050

[29] SibinDuan, Zhe Du, Hongsheng Fan, Rongming Wang, Nanostructure Optimization of Platinum-Based Nanomaterials for Catalytic Applications, nanomaterials, 2018, 8, 949; doi:10.3390/nano8110949

[30] Wolf, O.; Dasog, M.; Yang, Z.; Balberg, I.; Veinot, J.G.; Millo, O. Doping and quantum confinement effects in single Si nanocrystals observed by scanning tunneling spectroscopy. Nano Lett. 2013, 13, 2516–2521.

[31] Sichert, J.A.; Tong, Y.; Mutz, N.; Vollmer, M.; Fischer, S.; Milowska, K.Z.; Garcia Cortadella, R.; Nickel, B.; Cardenas-Daw, C.; Stolarczyk, J.K.; et al. Quantum size effect in organometal halide perovskite nanoplatelets. Nano Lett. 2015, 15, 6521–6527. [32] Wu, J.; Yang, H. Platinum-based oxygen reduction electrocatalysts. Acc. Chem. Res. 2013, 46, 1848–1857.

[33] Murali K, Neelakandan MS, Thomas S (2018) Biomedical Applications of Gold Nanoparticles. JSM NanotechnolNanomed 6(1): 1064.

[34] Kumar NS. BIST-BASED GROUP TESTING FOR DIAGNOSIS OF EMBEDDED FPGA CORES. International Journal of MC Square Scientific Research. 2009 Dec 20;1(1):20-5.

[35] Qi L, Gao X. Emerging application of quantum dots for drug delivery and therapy. Expert Opin DrugDeliv. 2008; 5: 263-267. [35] ChertokB, Moffat BA, David AE, Yu F, Bergemann C, Ross BD, et al. Iron oxide nanoparticles as a drug delivery vehicle for MRI monitored magnetic targeting of brain tumors. Biomaterials. 2008; 29: 487-496.