Editorial

IJCMER
www.ijcmer.org
INTERNATIONAL JOURNAL OF CHEMICAL, MATERIAL AND ENVIRONMENTAL RESEARCH
An International Open Free Access, Peer Reviewed Research Journal
2014, Vol. 1, No. (1): pg. 1-2

Nanotechnology: The Breakthrough in Water and Wastewater Treatment

Olushola S Ayanda*, Leslie F Petrik

Environmental and Nano Science Research Group, Department of Chemistry, University of the Western Cape, Private Bag X17, Bellville, South Africa

(Received: October 03, 2014; Accepted: October 23, 2014)

Nanotechnology is the engineering and application of atoms, molecules, and particles whose sizes are on the nanometer scale (1 - 100 nm). Studies have shown that nanoparticles (NPs), most especially the nano metal oxides have improved and/or unusual physico-chemical properties when compared with the corresponding bulk materials. Thus, these unique properties make NPs very useful in medicine, electronics, biomaterials, energy production, water and wastewater treatment, etc. Different methods such as the gas phase synthesis (gas condensation processing, chemical vapour condensation, microwave plasma processing, and combustion flame synthesis), ball milling, co-precipitation, sol gel, micro emulsion, and surfactant have been widely reported over the years for the production of NPs. There are conventional technologies which are affordable and can be produced locally for effective removal of contaminants from water and wastewater. However, there are several challenges with regards to the cost and the removal efficiency of certain pollutants, most especially, the persistent organic pollutants and endocrine disruptors by these conventional technologies. Environmental nanotechnology *vis.* nanotechnology and/or nanotechnology combined with conventional technologies are able to treat organic and inorganic contaminants to acceptable levels. There is currently intense scientific interest in nanotechnology for water and wastewater treatment; nevertheless, there are concerns about the toxicity and environmental impact of NPs.

Nano titanium dioxide, zerovalent iron, zinc oxide, silver oxide, carbon nanotube, and composites have been extensively used as photocatalysts, membranes and adsorbents in water and wastewater treatment. Chemically modified NPs have also attracted a lot of attention. The combination of NPs with other treatment processes such as the physical, chemical, biological, and advanced oxidation processes similarly yielded enhanced outcome. The application of nanotechnology for the removal of toxic pollutants such as the pharmaceutical and personal care products, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, phthalates, furans and dioxins, agrochemicals and pesticides, volatile organic compounds, viruses and bacteria, dyes, inorganic pollutants, etc. has been widely reported by several investigators in the field of nanotechnology. Some of the recently reported investigations include; the use of copper NPs in paper filters for point-of-use water purification by Dankovich and Smith [1], the adsorption of methylene blue onto synthesized nanoscale zerovalent iron-bamboo and manganese-bamboo composites by Shaibu et al. [2], the use of synthesized nano silver bioconjugate material for the treatment of organophosphorus pesticide reported by Das et al. [3], the removal of boron from water using iron oxide/hydroxide-based NPs (NanoFe) and NanoFe-impregnated granular activated carbon as adsorbent by Zelmanov and Semiat [4], and the application of green nano iron particles for the adsorptive removal of As(III) and As(V) from aqueous solution reported by Prasad et al. [5]. Moreover, the article by Cai et al. [6] focused on the desalination of seawater by nano Ag and Ag@C on graphene. A detailed review on the catalytic applications of Au/TiO_2 NPs for the removal of water pollutant was presented by Ayati et al. [7], while Ayanda et al. [8] and Fatoki et al. [9] evaluated the potential of nano oxides and composites for the remediation of organotin compounds (tributyltin and triphenyltin chlorides). Interestingly, results have shown that environmental nanotechnology could be effectively utilized for the removal of organic and inorganic contaminants from drinking water, sewage, municipal, industrial and process wastewater.

* Corresponding author:
osayanda@gmail.com
Published online at www.ijcmer.org

The limitation to the use of nanotechnology in water and wastewater treatment is that the NPs might be difficult to separate from the treated solution, which may results to loss of the NPs. Nevertheless, this problem could be reduced by immobilization of the NPs on appropriate substrate. The toxicity and environmental impact of NPs are also currently been investigated to understand their impact on human health and the environment.

Olushola S Ayanda
Leslie F Petrik

REFERENCES

[1] Dankovich T.A., Smith J.A., 2014. Incorporation of copper nanoparticles into paper for point-of-use water purification. Water Res., 63, 245-251.

[2] Shaibu S.E., Adekola F.A., Adegoke H.I., Ayanda O.S., 2014. A comparative study of the adsorption of methylene blue onto synthesized nanoscale zero-valent iron-bamboo and manganese-bamboo composites. Materials, 7, 4493-4507.

[3] Das S.K., Khan M.M.R., Guha A.K., Das A.R., Mandal A.B., 2012. Silver-nano biohybride material: Synthesis, characterization and application in water purification. Biores. Technol., 124, 495-499.

[4] Zelmanov G., Semiat R., 2014. Boron removal from water and its recovery using iron (Fe^{3+}) oxide/hydroxide-based nanoparticles (nanoFe) and nanoFe-impregnated granular activated carbon as adsorbent. Desalination, 333, 107-117.

[5] Prasad K.S., Gandhi P., Selvaraj K., 2014. Synthesis of green nano iron particles (GnIP) and their application in adsorptive removal of As(III) and As(V) from aqueous solution. Appl. Surf. Sci., 317, 1052-1059.

[6] Cai P.F., Su C.J., Chang W.T., Chang F.C., Peng C.Y., Sun I.W., Wei Y.L., Jou C.J., Wang H.P., 2014. Capacitive deionization of seawater effected by nano Ag and Ag@C on graphene. Mar. Pollut. Bull., 85, 733-737.

[7] Ayati A., Ahmadpour A., Bamoharram F.F., Tanhaei B., Mänttäri M., Sillanpää M., 2014. A review on catalytic applications of Au/TiO_2 nanoparticles in the removal of water pollutant. Chemosphere, 107, 163-174.

[8] Ayanda O.S., Fatoki O.S., Adekola F.A., Ximba B.J., 2013. Kinetics and equilibrium models for the sorption of tributyltin to nZnO, activated carbon and nZnO/activated carbon composite in artificial seawater. Mar. Pollut. Bull., 72, 222-230.

[9] Fatoki O.S., Ayanda O.S., Adekola F.A., Ximba B.J., 2014. Sorption of triphenyltin chloride to nFe_3O_4, fly ash and nFe_3O_4/fly ash composite material in seawater. Clean – Soil, Air, Water, 42, 472- 479.