Poll Res. 40 (2) : 506-508 (2021)
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ISSN 0257–8050

USING REDUCED GRAPHEME OXIDE TO REMOVE ARSENIC METALS FROM THE ENVIRONMENT

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(Received 18 October, 2020; accepted 13 November, 2020)

ABSTRACT

The current study aims to evaluate the adsorption process of the lead element in aqueous solution by means of nanomaterial (reduced graphene oxide) that was prepared from the reduction of graphene oxide GO prepared by the Hummers method "nanomaterial was diagnosed (rGO) and to study its properties and characteristics by means of a scanning electron microscope (SEM) and a microscope. Atomic force (AFM) results showed that the percentage of removal of the element increased with increasing time, and as the results recorded that the highest adsorption was at a concentration of 50 mg of elemental arsenic. This indicates that the removal rate decreases with increasing the initial concentration of the adsorbent

KEY WORDS : Graphene oxide, Removearsenic, SEM analysis, AFM analysisÜ

INTRODUCTION

Arsenic is one of the heavy metals that poses a health hazard (Hughes *et al*., 1988). Arsenic is a toxic element and is widely available in the form of oxides, sulfides or salts. The pollution that occurs due to arsenic is only a result of both natural geological processes and various human activities. Pollution resulting from natural phenomena includes volcanic eruptions and soil erosion and sedimentary rocks (ATSDR, 2000). The human sources of arsenic are various human activities such as mining and processing ores, as well as most paints, dyes, soaps and the like. Conductors, pesticides and fertilizers are sure to release arsenic in large quantities and in its inorganic forms, which are more dangerous to human health, causing cancer, especially liver, lung, bladder and skin cancer (Chowdhury *et al*., 2000).

Different treatment methods have been used for these minerals to reduce the percentage of pollution resulting from them. One of the most important methods is the use of nanomaterials as an adsorbent to remove these minerals (Singh, 2017). Nanoparticles have been used in various forms in many fields, including electronics, energy technology, and others, but studies on the use of graphene oxide in the treatment of heavy metals are very few.

MATERIALS AND METHODS

- Graphene oxide is prepared by Hummers Method.
- Graphene oxide reduction: The reduction of graphene oxide was performed by using Ascorbic acid (De Silva *et al.*, 2018)

Diagnosis of Reduced Graphene Oxide (rGO)

Reduced graphene oxide is diagnosed using various techniques such as SEM (Caroling *et al*., 2013), AFM (Rostamizadeh *et al.*, 2018).

Heavy metal (Arsenic) concentration preparation

0.1 g of the toxic element oxide (Arsenic oxide) was prepared and dissolved in 1000 ml of distilled water (Singh, 2017), then the following dilution was prepared: (50,75 ,100) mg/l of the element arsenic

Experiment of removing heavy metals with nanomaterials

250 ml flasks were prepared and arsenic was added

at a concentration of (50,75,100) mg/l volume was completed to 100 ml and the pH was adjusted to 6. The solution was distributed in tubes of 10 mL, then the nanomaterial was added with a weight of (15, 10, 15 mg), as it was added individually to the tubes and 4 replicates were made for each weight. Then the author used the vortex device to mix the samples and left 24 hours after that we used a centrifuge, then the samples were filtered and examined with an atomic absorption device and the percentage of removal was calculated (Hadavifar *et al.,* 2014).

Statistical analysis

The results were analyzed statistically with ANOVA-tow way program.

RESULTS AND DISCUSSION

SEM analysis of rGO reductase graphene oxide

Surface studies of the shape and size of rGO samples were performed by scanning electron microscopy (SEM) to discover GO reduction with ascorbic acid and rGO (rGO). The results were well reduced in graphene oxide GO with ascorbic acid. After reduction, the reduced graphene oxide rGO appeared as crumpled nanoparticles. The results are consistent with previous studies (Abdolalhad *et al*., 2013).

AFM analysis of rGO reductase graphene oxide

The AFM image of rGO nanoparticles was synthesized by GO reduction of graphene oxide with ascorbic acid, which gave information about the shape of the rGO nanoparticles and the mean diameter and roughness. AFM analysis revealed the three-dimensional shape and average diameter of the nanoparticles nm) and the AFM image distribution indicated that the rGO grain size was 129.53 nm.(Gurunathan *et al*., 2014b) showed that LAA-rGO was thicker than GO.

Variation of the ability of graphene oxide (rGO) to remove heavy metal (Arsenic) from their solutions arsenic (As) at concentrations of (50,75, 100) mg/l.

Table 1 and Figure 3 showed that graphene oxide (rGO) in all its concentrations (5,10,15) has the ability to remove elemental arsenic at concentrations of (50,75,100) where the highest removal of nanocarpine oxide was in a concentration of 15 mg and the lowest removal was at a concentration of 5 mg.

The results of the statistical analysis showed that when the concentrations of nanomaterials (reduced graphene oxide) increased, this would led to an increase in the percentage of removal, as it was observed that the highest percentage of removal was at a concentration of 15 mg of reduced graphene oxide, and the reason for this is due to the increase in the concentration of the nanomaterial will Increase its surface area, and thus its adsorption capacity becomes high (Thomes and Raja, 2006). These results are consistent with previous studies (Kanel *et al.,* 2005; Kumar *et al*., 2014). Through the results of the current study, it was also observed that the

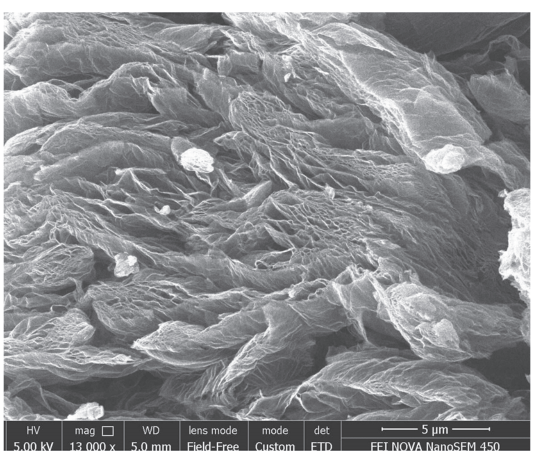

Fig. 1. SEM micrograph for fabrication of rGO nanoparticles resulting from the reduction of graphene oxide with ascorbic acid was a multi-layer crumpled nanoparticle shape of 13000X magnification and 5kv voltage

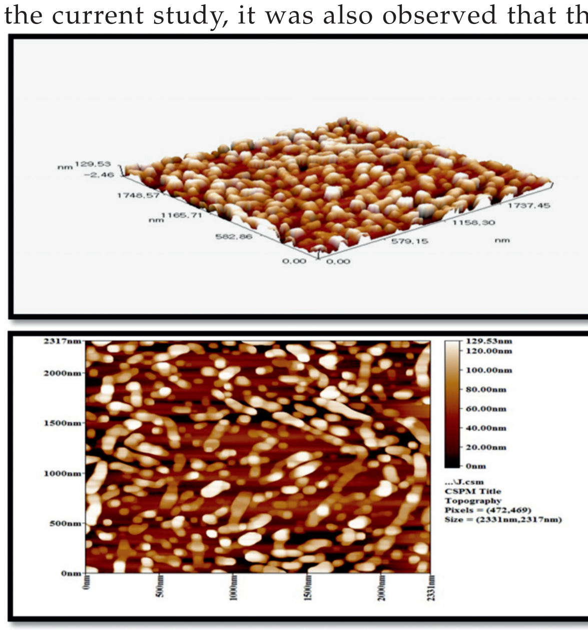

Fig. 2. Atomic force microscopy analysis of reduced graphene oxide resulting from GO reduction with ascorbic acid showing three dimensions of nanoparticles

Table 1. Results of the efficacy of reduced graphene oxide ((rGO) at concentrations of (5, 10, 15) mg in removing elemental arsenic at concentrations of (50, 75, 100) mg/l.

P value	LSD	Control	Graphenoxied 15 mg	Graphenoxied 10 mg	Graphenoxied 5 mg	Nanomaterial Heavy metal	No.
0.0002	0.0084	0.099K	0.01075G	0.03625d	0.061A	Arsenic 50 mg/l	1
0.0002	0.0084	0.099K	0.026H	0.04425e	0.07475B	Arsenic 75 mg/l	2
0.0002	0.0084	0.099K	0.0445J	0.06475f	0.08375C	Arsenic 100 mg/l	3
	0.0018	0.0018	0.0018	P value			

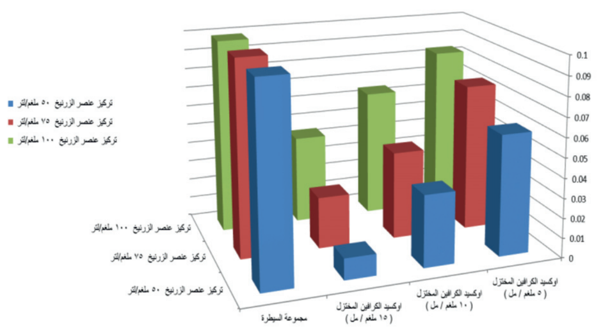

Fig. 3. Results of the efficacy of reduced graphene oxide ((rGO) at concentrations of (5, 10, 15) mg in removing elementalarsenic at concentrations of (50, 75,100) mg / liter.

highest adsorption was at a concentration of 50 mg / l of elemental arsenic. These results are consistent with previous studies (Sharma *et al.*, 2015; Mustaqeem *et al.*, 2015), which means that the percentage of removal decreases with increasing the initial concentration for the adsorbent.

REFERENCES

Abdolahad, M., Janmaleki, M., Mohajerzadeh, S., Akhavan, O. and Abbasi, S. 2013. Polyphenols attached graphene nanosheets for high efficiency NIR mediated photodestruction of cancer cells. *Materials Scien. Engin.*: C, 33 : 1498-1505.

ATSDR, 2000. Toxicological profile for arsenic TP-92/09. Center for Disease Control, Agency for Toxic Substances and Disease Registry, Atlanta, GA

Caroling, G., Tiwari, S.K., Ranjitham, A.M. and Suja, R. 2013. Biosynthesis of silver nanoparticles using aqueous broccoli extractcharacterization and study of antimicrobial, cytotoxic effects. Asian J. Pharm. *Clin. Res.* 6 (4) : 165-172.

Chowdhury, U. K., Biswas, B. K., Chowdhury, T. R., Samanta, G., Mandal, B. K., Basu, G. C. and Roy, S. 2000. Groundwater arsenic contamination in Bangladesh and West Bengal, India. *Environmental Health Perspectives.* 108(5) : 393-397.

De Silva, Huang, K. K. H.; H. H. and Yoshimura, M. 2018. Progress of reduction of graphene oxide by ascorbic acid. *Applied Surface Science.* 447 : 338-346

Gurunathan, S., Han, J. W., Park, J. H., Eppakayala, V. and Kim, J. H. 2014b. Ginkgo biloba: a natural reducing agent for the synthesis of cytocompatible graphene. *Intern. J. Nanomed.* 9 : 363.

Hadavifar, M., Bahramifar, N., Younesi, H. and Li, Q. 2014. Adsorption of mercury ions from synthetic and real wastewater aqueous solution by functionalized multi-walled carbon nanotube with both amino and thiolated groups. *Chemical Engineering Journal.* 237 : 217-228.

Hughes, J. P., Polissar, L. and Van Belle, G. E. R. A. L. D. 1988. Evaluation and synthesis of health effects studies of communitiessurrounding arsenic producing industries. *International Journal of Epidemiology.* 17 (2) : 407-413.1

Kanel, S. R., Mannig, B., Charlet, L. and Choi, H. 2005. Removal of arsenic (III) from groundwater by Zero-valent iron. *Environ Sci Technol.* 39 : 1291-98.

Kumar, S., Nair, R., Pillai, P. B., Gupta, S. N., Iyengar, M. A.R. and Sood, A.K. 2014. Graphene Oxide-MnFe2O4 Magnetic Nanohybrids for Efficient Removal of Lead and Arsenic from Water. *ACS Appl Mater Inter.* 6 : 1742.

Mustaqeem, M., Bagwan, M.S. and Patil, P.R. 2015. Adsorption of Ni (II) ion from metal solution using natural adsorbents. *International Journal of Emerging Trends in Engineering and Development.* 4 (5) : 33-43.

Rostamizadeh, K. Manafi, M. Nosrati, H. Manjili, H.K. and Danafar, H. 2018. Methotrexate conjugatedmPEG-PCL copolymers: a novel approach for dual triggered drug delivery. *New J. Chem.* 42 : 5937-5945.

Sharma, S.K., Mahiya, S. and Lofrano, G. 2015. Removal of divalent nickel from aqueous solutions using Carissa carandas and *Syzygiu maromaticum* : isothermal studies and kinetic modeling. *Applied Water Science.* DOI 10.1007/s13201-015-0359-y.

Singh, N., Kumar, D. and Sahu, A. P. 2007. Arsenic in the environment: effects on human health and possible prevention. *Journal of Environmental Biology.* 28(2): 359.

Thomas, J.M. and Raja, R. 2006. *Top.Catal.* 40 : 3-17.