

DEVELOPMENT OF GRAPHENE OXIDE BASED MATERIALS FOR WATER TREATMENT

Ana Cecilia Reynosa Martínez, Centro de Investigación y de Estudios Avanzados del IPN
(cecilia.reynosa@cinvestav.edu.mx)

Eddie López-Honorato, Centro de Investigación y de Estudios Avanzados del IPN
(eddie.lopez@cinvestav.edu.mx)

INTRODUCTON

Water contamination with arsenic is a great challenge affecting millions of people worldwide. This problem becomes even more challenging in arid and semi-arid regions where contaminated wells lakes or rives are the only source of fresh water. For example, in Mexico 13 states out of 32 (almost half of the territory) have shown water sources contaminated with this element, reaching concentrations up to 0.6 mg/L, surpassing the concentration recommended by the World Health Organization of 10 µg/L (Armienta *et al.*, 2008)

Although there are different technologies to remove arsenic, adsorption is considered economic and easy to use, making it a suitable option for water treatment. However, many adsorbent materials lack selectivity towards a specific element. This selectivity becomes important in hard waters (generally found in arid and semi-arid regions) where high concentration of secondary salts such as phosphates PO₄³⁻, sulfates SO₄²⁻ and carbonates CO₃²⁻, tend to dramatically reduce the adsorption capacity of adsorbent materials. It is for this reason that is necessary to develop adsorbent materials capable of adsorbing selectively arsenic despite the presence of secondary salts.

AVAILABLE BACKGROUND INFORMATION& DATA

In this work the graphene oxide (GO) was synthesized by the improved Hummers method, later was functionalized with sulfanilic acid (SA-GO) in order to obtain an adsorbent material with the capability to adsorb As even in the presence of PO₄³⁻, SO₄²⁻ and CO₃²⁻. These materials were characterized by FT-IR, XPS and Zeta potential. Then adsorption tests were performed in order to study the pH effect, the interfering ions and the isotherm model. A DFT computational modeling was performed too to explain the interaction between As and the functional groups of adsorbent materials. Finally a cytotoxicity test was performed to compare the toxicity for pristine GO and SA-GO.

BRIEF STATE OF THE ART

The GO is a carbon-based material with a hexagonal structure of sp² and sp³ hybridization, in the basal plane has hydroxyl and epoxide groups and in the edges has carbonyl and carboxyl groups. This functional groups has an important role in the GO properties such as good stability and high surface area (Kyzas *et al.*, 2014). Nevertheless, the presence of PO₄³⁻, SO₄²⁻ and CO₃²⁻ reduce its adsorption capacity and its efficiency.

SUMMARY

The maximum adsorption capacity of the functionalized adsorbent material was 90 mg/g a good adsorption capacity compared with material functionalized with a high percentage of FeOx. The maximum adsorption capacity reported in the literature, for GO functionalized with FeOx, goes from 54.2 to 147 mg/g (Cao *et al.*, 2019; Li *et al.*, 2019). Further the AS-OG keeps its adsorption capacity in presence of ions such as PO₄³⁻, SO₄²⁻ and CO₃²⁻ even in high concentrations and has a good stability in suspension which promotes a good interaction with As species.

REFERENCES

Armienta, Segovia (2008). Arsenic and fluoride in the groundwater of Mexico. Environmental Geochemistry and Health, vol. 30, no. 4, pp. 345-353.

Cao, Ma, Zhao, Musante, White, Wang, Xing (2019). Interaction of graphene oxide with co-existing arsenite and arsenate: Adsorption, transformation and combined toxicity. Environment international, vol. 131, p. 104992.

Kyzas, Deliyanni, Matis (2014). Graphene oxide and its application as an adsorbent for wastewater treatment. *Journal of Chemical Technology & Biotechnology*, vol. 89, no. 2, pp. 196-205.

Li, Zhu, Wang, Fang, Zhu, Wang (2019). Exposure to graphene oxide at environmental concentrations induces thyroid endocrine disruption and lipid metabolic disturbance in *Xenopus laevis*. *Chemosphere*, p. 124834.

EXCEED - SWINDON Conference 2019

THE FUTURE OF WATER RESOURCES

October 13th - 16th, Mérida, Mexico



Programme and Book of Abstracts

PROGRAMME

Sunday, 13 th		Arrival	
19:00	-	21:00	Welcome cocktail

Monday, 14 th		Conference Day 1	
08:30	-	09:00	Registration
09:00	-	09:30	Opening Ceremony <ul style="list-style-type: none"> • Norbert Dichtl • Andreas Haarstrick • Rodolfo Silva • Local authority
09:30	-	10:00	Keynote speech <ul style="list-style-type: none"> • Norbert Dichtl
10:00	-	10:10	Break
Session 1: The impact/performance/role of SDGs Chairman: Valeria Chávez			
10:10	-	10:30	Exploring some ocean energy possibilities in Latin America (Jassiel Hernández)
10:30	-	10:50	Water energy nexus in the MENA region (Abbas Al-Omari)
10:50	-	11:10	Ocean energy and marine biodiversity affectations: a life cycle assessment review (Dora Ruiz-Méndez)
11:10	-	11:40	Coffee Break
Session 2: Water-Energy-Nexus (I) Chairman: Dwi Andreas Santosa			
11:40	-	12:00	Wastewater/waste to energy in MENA region: A review for opportunities (Zeinab Abou Elnaga)
12:00	-	12:20	Water-energy nexus in a wastewater treatment plant: Energy efficiency and recovery (Wang Hongtao)
12:20	-	12:40	From wastewater treatment plants to a resources recovery facility (Marcelo Nolasco)
12:40	-	13:00	Seasonal assessment of the energetic potential associated with salinity gradient: Champoton River, Mexico (Gregorio Posada Vanegas)
13:00	-	14:30	Lunch
Session 3: Water, ecosystem and socio-economic integrating aspects (I) Chairman: Germán Rivillas			
14:30	-	14:50	Decolourization and mineralization of acid green 25 dye through single and catalytic ozonation (Liliana Amaral Féris)

14:50	-	15:10	Adsorption of naphtholate-as dye in wastewater of batik industry using green synthesized zn layered hydroxyl salts (Sri Juari Santosa)
15:10	-	15:30	Adsorption of hexavalent chromium in coal beneficiation tailing in fixed bed column (Liliana Amaral Féris)
15:30	-	15:50	Kinetics of the adsorption of anionic and cationic dyes in aqueous solution by low-cost activated carbons prepared from sea cake and cotton cake (Ibrahim Tchakala)
15:50	-	16:10	Distribution of microplastics in water and sediment in a Biosphere Reserve (Cecilia Enriquez)
16:10	-	16:30	Evaluation of microplastics contamination in the margins of the Patos Lagoon in south of Brazil (Eduardo Saldanha Vogelmann)
16:30	-	17:00	Coffee Break
Session 4: Water, ecosystem and socio-economic integrating aspects (II) Chairman: Rodolfo Silva			
17:00	-	17:20	Hydrodynamic modelling of the Huave Lagoon System, Oaxaca (María Fernanda González Amador)
17:20	-	17:40	Impact effects of hard infrastructure in Salamanca Natural Park (Juan Carlos Caez-Perez)
17:40	-	18:00	The decision-making in face to coastal squeeze, analysis between social and economic impacts: Case study of Campeche, Mexico (Debora L. Ramírez-Vargas)
18:00	-	18:30	Keynote speech • Elvis Carissimi
20:00			Dinner

Tuesday, 15th		Conference Day 2	
Session 5: Water, ecosystem and socio-economic integrating aspects (III) Chairman: Arwa Naser Damen Hamaideh			
09:00	-	09:20	Dispersion of submarine groundwater discharges in reef lagoons and associated environmental effects (Arlett Rosado Torres)
09:20	-	09:40	Salt intrusions into a freshwater spring in a tropical coastal lagoon, Yucatán, Mexico (Xaní Malagón)
09:40	-	10:00	Variability of the saline gradient in a hypersaline coastal lagoon (Brenda Natalia Fitch Geymonat)
10:00	-	10:20	Sedimentation and water quality status of lake Tana, the headwaters of the Blue Nile, Ethiopia (Seifu A Tilahun)
10:20	-	10:40	An innovative approach to mitigate risks on the existing iron tailings dams in Brazil (Jose Araruna)

10:40	-	11:00	Urban sustainable water management and water efficiency improvement for buildings – a case study for Istanbul (Ahmet Baban)
11:00	-	11:30	Coffee Break
Session 6: Water-Energy-Nexus (II) Chairman: Eduardo Saldanha Vogelmann			
11:30	-	11:50	Reverse electrodialysis for energy and water: coupled systems based in salinity gradients (Mateo Roldan-Carvajal)
11:50	-	12:10	Development of graphene oxide membranes for its use in reverse electrodialysis systems (Eddie López Honorato)
12:10	-	12:30	Development of graphene oxide based materials for water treatment (Ana Cecilia Reynosa Martinez)
12:30	-	12:50	Laboratory experiences on marine energy conversion devices for supplying electricity demand of remote coastal communities (Jassiel Hernández)
12:50	-	13:10	Plate type obstacles used for coastal protection and power generation (Luis Eduardo Pérez Paez)
13:10	-	14:40	Lunch
Session 7: Water, ecosystem and socio-economic integrating aspects (IV) Chairman: Thi Thanh Van Ngo			
14:40	-	15:00	Evaluating combinatorial water treatment by locally available materials (Chrispin Kowenje)
15:00	-	15:20	Desalination by capacitive deionization as a tool to provide drinkable water to small communities in the Brazilian semiarid (Luis Augusto Martins Ruotolo)
15:20	-	15:40	Fluoride ions removal from groundwater by alumina adsorption (Elvis Carissimi)
15:40	-	16:00	Bio-refineries: A new concept towards green energy production from agroindustrial wastewater (Víctor Alcaraz)
16:00	-	16:20	The importance of water and nutrients management in paddy fields as an effort to increase crop yields and producing an electrical energy through microbial fuel cells (Dwi Andreas Santosa)
16:20	-	16:50	Coffee Break
16:50	-	17:20	Keynote speech • Klaus Fricke
16:50	-	18:00	Panel discussion Moderators: Edmilson Santos de Lima and Norbert Dichtl
20:00			Gala dinner