Journal of Environmental Analytical Chemistry

Singhal, J Environ Anal Chem 2015, 2:3
DOI: 10.4172/2380-2391.1000e113

Editorial

Open Access

Potential Applications of Graphene to Improve the Quality of Potable Water

RK Singhal*

Analytical Chemistry Division, Bhabha Atomic Research Centre, Trombay, Mumbai, India

Graphene is the subject of worldwide research and is thought to be able to revolutionize whole water treatment industries along with others. Graphene is a two dimensional mesh of carbon atoms arranged in the form of a honeycomb lattice as shown in Figure 1. Among researchers it is popularly known as "miracle material" because this one atom thick substance (to make a 1mm thick sheet one has to stack around three million layers of it) is the lightest, strongest, thinnest, best heat-and-electricity conducting material.

As per world population growth trends, we are supposed to augment our sources of potable water so that we can provide safe drinking water, for more than 11 billion people by 2050. In view of this, the responsibility of environmental analytical technocrats involved in water treatment technology is multifold for looking into new and effective way to improve the quality of wastewater so that it can be effectively use for various households and industrial purposes. Water is an invaluable resource and the intelligent use and maintenance of water supplies is one of the most important and crucial challenges that stand before mankind. New technologies are constantly being sought to lower the cost and footprint of processes that make use of water resources, as potable water (as well as water for agriculture and industry) are always in desperate demand. Much research is focused on graphene for different water treatment uses, for elimination of bacteria and other contaminants.

Graphene's hydrophobic property makes its most useful for water treatment. Graphene naturally repels water, but when narrow pores are made in it, rapid water permeation is allowed. In view of this various researches were involved in synthesis of porous Graphene sheets (perforated with miniature holes). Nanopores can be introduced in graphene by a variety of methods, including helium ion beam drilling and chemical etching. In their simulations, the scientists strengthened the nanopores by passivating, or shielding, each carbon atom at the pore edge with either hydrogen atoms or hydroxyl groups. These porous graphene sheets are able to let water molecules pass but block the passage of contaminants and substances. Graphene's small weight and size can contribute to making a lightweight, energy-efficient and environmental friendly generation of water filters. It has been discovered that thin membranes made from graphene oxide are impermeable to all gases and vapors, besides water, and further research revealed that an accurate mesh can be made to allow ultrafast separation of atomic species that are very similar in size - enabling super-efficient filtering. This opens the door to the possibility of using seawater as a drinking water resource, in a fast and relatively simple way

Figure 1: Typical structure of Graphene.

At present in our labs we are working on developing template for hosting Graphene suspension. These Graphene impregnated template will be used to remove heavy metal contaminant form potable water without disturbing the various drinking water quality parameters. Graphene oxide (GO) suspension has successfully been impregnated into calcium alginate matrix and spherical beads were formed as shown in Figure 2. The optimised composition for the calcium alginate graphene beads was 4 % (wt/vol) alginate as basic template in which 1.5 % (wt/vol) grephene was loaded. The beads are formed by a simple displacement reaction where two Na^+ ions are replaced by one Ca^{2+} ion and in that process it impregnates GO and forms bead [1]. These beads can be used successfully for removal of various heavy metals (Th, U, Hg, Cd and Pb) as well as organic pollutants (humus materials) from aquatic stream after optimization of various parameters. Researchers also synthesize a new Graphene-carbon nanotube-iron oxide (G-CNT-Fe) 3D functional nanostructure. These unique 3D structures proves to be excellent arsenic absorbents, as revealed from the study of arsenic adsorbed 3D structures by using Scanning Electron Microscope-Energy dispersive Spectrometry (SEM-EDS). Carbon nanotubes vertically standing on Graphene sheets and iron oxide nanoparticles are well distributed on both the Graphene and the CNTs. These are excellent to absorb arsenic due to the high surface-to-volume ratio and open pore network [2].

Various researchers were also working to make desalination techniques more energy-efficient and less expensive to be sustainable by using nanoprous Graphene. These newly developed nanoporous Graphene can filter salt from water at a rate that is 2-3 orders of magnitude faster than today's best commercial desalination technology, reverse osmosis (RO). The researchers predict that graphene's superior water permeability could lead to desalination techniques that require less energy and use smaller modules than RO technology, at a cost

***Corresponding author:** RK Singhal, Analytical Chemistry Division, Bhabha Atomic Research Centre, Trombay, Mumbai-400085, India, Email: rsinghal@barc.gov.in

Received May 05, 2014; **Accepted** May 12, 2015; **Published** May 20, 2015

Citation: Singhal RK (2015) Potential Applications of Graphene to Improve the Quality of Potable Water. J Environ Anal Chem 2: e113. doi:10.4172/2380-2391.1000e113

Figure 2: Graphene impregnate Calcium alginate beads.

that will depend on future improvements in Graphene fabrication methods [2]. Although oceans and seas contain about 97 % of Earth's water, currently only a fraction of a percent of the world's potable water supply comes from desalinated salt water. In view of this, nanoporous graphene can resolve the water crisis in many parts of the world. Overall, work carried out by various researches clearly indicates that nonporous Graphene were completely revolutionizing the technology of removing the various contaminants form potable water.

References

1. Basu H, Singhal RK, Pimple MV, Reddy AVR (2015) Arsenic removal from ground water by goethite impregnated calcium alginate beads. Water, Air, and Soil pollution 226: 22.
2. Ray PZ, Shipley HJ (2015) Inorganic nano-adsorbents for the removal of heavy metals and arsenic: a review. RSC Adv 5: 29885-29907.