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Water Pollution Removal by Nanotechniques

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ABSTRACT: The rapidly increasing population, depleting water resources, and climate change resulting in prolonged droughts and floods have rendered drinking water a competitive resource in many parts of the world. The development of cost-effective and stable materials and methods for providing the fresh water in adequate amounts is the need of the water industry. Traditional water/wastewater treatment technologies remain ineffective for providing adequate safe water due to increasing demand of water coupled with stringent health guidelines and emerging contaminants. Nanotechnology-based multifunctional and highly efficient processes are providing affordable solutions to water/wastewater treatments that do not rely on large infrastructures or centralized systems.

KEYWORDS: nanotechniques, water, pollution, wastewater, treatment, contaminants, efficient, population

I. INTRODUCTION

Surface water is extremely susceptible to pollution stemming from human activities, such as the expansion of urban and suburban areas, industries, cities, and agriculture. In fact, sources of surface water have become the most common discharge sites for wastewater, which may contain microorganisms, pharmaceutical waste, heavy metals, and harmful pollutants. As a reference standard for clean water, the water quality standards and index of Malaysia were used. In comparison with conventional wastewater treatment methods, new nanomaterial-based methods for water filtration and purification are drawing attention as more efficient methods for water pollution detection and treatment. This prompts the use of nanotechnology applications to control surface water pollution and quality, as surface water is the main source of water consumption for humans, animals, and plants. [1,2]

Nanotechnology is being used to develop solutions to three very different problems in water quality. One challenge is the removal of industrial water pollution, such as a cleaning solvent called TCE, from ground water. Nanoparticles can be used to convert the contaminating chemical through a chemical reaction to make it harmless. Studies have shown that this method can be used successfully to reach contaminates dispersed in underground ponds and at much lower cost than methods which require pumping the water out of the ground for treatment.

Another challenge is the removal of salt or metals from water. A deionization method using electrodes composed of nano-sized fibers shows promise for reducing the cost and energy requirements of turning salt water into drinking water.

The third problem concerns the fact that standard filters do not work on virus cells. A filter only a few nanometers in diameter is currently being developed that should be capable of removing virus cells from water.

Researchers at the University of Tokyo have demonstrated the use of fluorine nanochannels to remove salt from water.

Researchers at EPFL have demonstrated a solar powered water filter that uses titanium dioxide (TiO₂) nanowires and carbon nanotubes to purify water.

Researchers at Brown University have demonstrated how to create water filters using short channels between graphene sheets that can allow water to pass but blocks larger contaminates.

Researchers at Northwestern University have developed a nanocomposite coating that can be applied to a sponge causing the sponge to absorb oil, but not absorb water.



Researchers at Nagoya University have demonstrated the use of nanocarbons modified with amino groups to remove heavy metal ions from water.

Researchers at the RMIT University and University of New South Wales have demonstrated a filter made with nano-thin sheets of aluminium oxide which can filter both heavy metals and oils from water.[3,4]

Using nanoscavengers, in which a layer of reactive nanoparticles coat a synthetic core which is designed to be easily magnetized. The nanoparticles, for example silver nanoparticles if bacteria is a problem, attach to or kill the pollutants. Then when a magnetic field is applied the nanoscavengers are removed from the water.

Using pellets containing nanostructured palladium and gold as a catalyst to breakdown chlorinated compounds contaminating groundwater. Since palladium is very expensive the researchers formed the pellets of nanoparticles that allow almost every atom of palladium to react with the chlorinated compounds, reducing the cost of the treatment.

Using enzyme-functionalized micromotors to remove carbon dioxide from water.

Researchers at the University of Cincinnati have demonstrated a method of removing antibiotics contaminating waterways. The method uses vesicle nanoparticles that absorb antibiotics.

Using graphene oxide to remove radioactive material from water. Researchers found that flakes of graphene oxide absorb radioactive ions in water. The graphene oxide then forms clumps that can be removed from the water for disposal.

Using graphene as a membrane for low cost water desalination. Researchers have determined that graphene with holes the size of a nanometer or less can be used to remove ions from water. They believe this can be used to desalinate sea water at a lower cost than the reverse osmosis techniques currently in use.[5,6]

Using carbon nanotubes as the pores in reverse osmosis membranes. This can decrease the power needed to run reverse osmosis desalination plants because water molecules pass through carbon nanotubes more easily than through other types of pores. Other researchers are using carbon nanotubes to develop small, inexpensive water purification devices needed in developing countries.

Also carbon nanotubes are being developed to clean up oil spills. Researchers have found that adding boron atoms during the growth of carbon nanotubes causes the nanotubes to grow in a sponge like material that can absorb many times its weight in oil.

Using hair like nanoparticles (nano-hair) to trap and measure the level of mercury pollution in water.

Combining a nanomembrane with solar power to reduce the cost of desalinating seawater

Using iron nanoparticles to clean up carbon tetrachloride pollution in ground water

Adding graphene oxide to sand filters to enhance their ability to remove pollutants from water.

Using silver chloride nanowires as a photocatalysis to decompose organic molecules in polluted water.

Using an electrified filter composed of silver nanowires, carbon nanotubes and cotton to kill bacteria in water.

Nanoparticles that can absorb radioactive particles polluting ground-water

Coating iron nanoparticles allow them to neutralize dense, hydrophobic solvents polluting ground-water

Using nanowire mats to absorb oil spills

Using iron oxide nanoparticles to clean arsenic from water wells.

Using gold tipped carbon nanotubes to trap oil drops polluting water.

Using antimicrobial nanofibers and activated carbon in a disposable filter as an inexpensive way to clean contaminated water.[7,8]



II. DISCUSSION

Researchers at Pacific Northwestern Laboratory have developed a material to remove mercury from groundwater. The material is called SAMMS, which is short for Self-Assembled Monolayers on Mesoporous Supports. This translates taking a ceramic particle whose surface has many nano-size pores and lining the nanopores with molecules that have sulfur atoms on one end, leaving a hole in the center that is lined with sulfur atoms as shown in figure-SAMMS. They line the nanopores with molecules containing sulfur because it bonds to mercury, so mercury atoms bond to the sulfur and are trapped in the nanopores.

The issue of water analysis has become a big issue in today's world. Water pollution mainly caused by organic and inorganic solutes, heavy metals (Hg,As,Pb,Cr,Cu,Zn,Cd etc) from human activities or industrial processes. This water pollution results different human health problems as well as destruction of biodiversity. The water pollution level that is increasing day by day it immediately need better development and discoveries of different technology. Nanotechnology offers many advantages to improve environmental technologies and also create new water pollution control technology that is better than the current technology.[9,10]

Crowded, expanding cities in many parts of the world are experiencing an increased demand for fresh water, and planners are unclear as to how the water needs of tomorrow will be met. In cities such as Bangalore, where data are currently the most valuable commodity, we believe that a data ecosystem could be created for water. Focus on water availability is likely to create businesses, drive the economy, and make the world breathe better. Taking a specific case, India has just 4% of the global freshwater resources but ~18% of the world's population. The country, which was largely rural years ago, has en masse become urban in the past two decades. The urban population has risen from 28% in 2000 to 33% in 2016. (1) With a growth rate over 6% in gross domestic product (GDP), the most populous countries, such as India and China, are increasing their chemical, pharmaceutical, agrochemical, automotive, petrochemical, semiconductor, and many other outputs, which will eventually "enrich" our ecosystem materially. Simultaneously, their rapidly declining water resources will be burdened by unprocessed industrial waste. The World Bank has predicted that achieving a growth rate of 8% or above for India will be possible only with a robust water management system. (2) These emerging issues, similar to those existing throughout the world, present a complicated suite of problems that will require technological advances, limits on usage, and collective wisdom, and compassion in order to create sustainable solutions. For instance, the control over carbon emissions by developed countries is probably not the reason for the globe's survival, but the lack of development in less-developed countries is, according to the Intergovernmental Panel on Climate Change (IPCC). (3) Sustainable economic and technological development for all is needed, although acquiring a quality of life comparable to the United States for the rest of the world would require significant advances in treating, purifying, and assessing toxicity in water. Clean water challenges are highly interdisciplinary, and solutions therefore must cut across boundaries of disciplines. Water in diverse forms is related to climate, food, health, and many other aspects of life, including its origin. The need for urgent, concerted action is clear from just one observation: ca. 83% of freshwater species have declined in the last 50 years. (4) Water is and will continue to be one of the most important interdisciplinary subjects of research.[11]

Recent advances in the field of nanoscience provide many solutions to alleviate needs with regard to reducing scarcity or removing contamination. For example, there are filters that remove pesticides from drinking water using nanochemistry. (5-8) This technology had already reached over 7.5 million people by 2016, when implementation data were last collected, reducing pesticide levels from over 20 times the safety standard to concentrations substantially below it (0.5 parts per billion, ppb, for all pesticides taken together). (9) In another example, a nanostructured material is able to remove arsenic from drinking water affordably and the technology is delivering clean water (CW) to about 1 million people each day, providing hope for another 80 million or so in India, who are affected by this problem.[12] The government of India has approved the technology for national implementation. Such a solution does not require electricity and is affordable, even for those living in the poorest parts of the world. Several alternate solutions to address arsenic as well as other organic and inorganic contaminants are available and are being explored in various parts of the world. Alternate methods of microbial disinfection, desalination, water harvesting, recycling, contaminant sensing, and monitoring are debuting in the marketplace. Scalability and massive implementation of technologies is slow but encouraging. For example, the prospects of nanotechnology (NT) for CW have enthused many researchers, and numerous articles have been published around the theme of NT and nanomaterials for CW production and wastewater treatment. [13] Among several issues of relevance for developing affordable NTs for CW, there are four principal points to be considered: (1) More for less: As constituent materials reduce in dimension and reach the nanoscale regime, their effective capacity to remove contaminants increases due to additional derivatization of the



material to increase charge, solubility, affinity, etc. Properties of relevance, such as the presence of active surface sites for adsorption, enhanced adsorption enthalpy for specific species, reactivity as a result of activation of specific chemical bonds, size-dependent optical absorption, and emission, are being explored today. All of these properties individually and collectively make it possible to acquire more effective scavenging capacity per unit mass of the material at the nanoscale than the bulk material, making a purifier composed of nanoscale material smaller and more affordable. (2) Decreasing limits of contaminants: The World Health Organization (WHO) set the upper limit on arsenic in drinking water at 50 ppb in 1963, and the U.S. Environmental Protection Agency decreased the limit to 10 ppb in 2002. A primary reason for decreasing contaminant limits has been an enhanced understanding of the effects of contaminants on human health. However, the limited availability and high cost of remedial technologies have kept governments from implementing these standards. Moreover, the actual safe limit is expected to be further below the present WHO limit. This is because the arsenic intake per capita per day through drinking water is much higher than that assumed by the WHO in the arsenic-affected tropical regions of India due to unaccounted sources of arsenic intake, such as food crops. In addition to India, South Asian countries including Vietnam and Bangladesh, and Latin American countries including Argentina, Bolivia, Chile, and others including regions of the United States are also prone to alarming levels of arsenic. In order to accomplish the already prescribed limits, nanomaterials are essential. (3) What are achievable levels of contaminant removal using advanced materials? Single nanoparticles (NPs) have even shown sensitivity to a few species of contaminants. Thus, even at this level of contaminant concentration, several materials are selective in removing them. (4) Special properties: The unique properties of nanostructures, such as atomically precise pores and thicknesses of desired dimensions, controlled functionalities, maneuverability, etc., offer exciting possibilities for making CW.[14]

III. RESULTS

Throughout history and into the present, water filtration and purification components are primarily made of carbon. Using carbon in the form of wood charcoal for water purification was practiced by Egyptians and Sumerians in 3750 BC. Activated carbon, introduced in the 1940s, and its various modifications, including nanostructures such as carbon nanotubes (CNTs), carbon nanofibers (CNFs), and graphene-based materials have been exploited for treatment through mechanisms such as adsorption, catalytic wet air oxidation, membrane-based separation, and disinfection, and also for sensing and monitoring. Metal and metal oxide NPs have also been reported for adsorption, photocatalysis, oxidation, disinfection, and sensing. Despite being an active research area for decades, nanomaterials-based treatment and sensing technologies are yet to occupy a large share of the market due to unreliability in terms of sensitivity and selectivity, higher cost, and field-level issues during operation. CNF films for biocidal activity, silver nanobrushes for atmospheric water harvesting, graphene-CNT-iron oxide nanostructures, and ferrihydrite for heavy-metal removal. These have reached people in the form of affordable and easy-to-operate devices such as filtration-incorporated hand pumps, desalination units, (36) and atmospheric water generators. We discuss the future of nanomaterials that can be integrated into these technologies to overcome the existing challenges.

Nanophotocatalysis has reflected a vital role for the mineralization of dangerous organic substances at 25 °C and proved very effective and efficient method for detoxification of water with help of nanophotocatalysts. Furthermore, mostly nanophotocatalysts show some advantages such as they are less toxic, having low-cost, chemically stable, easily accessible and excellent photoactive properties with nano size i.e., 1–100 nm range. Generally, nanophotocatalysts present various advantages such as stability (chemical/physical), low cost and eco-friendliness. Among them, TiO₂ having good photostability but many nanophotocatalysts, such as zinc oxide, metal sulfide materials, copper-based materials, and so on exhibit relatively low chemical stability due to photocorrosion. As light shine on them, they oxidized or reduced depend on materials and their oxidation states changes by generating holes or electrons, which leads to decomposition of photocatalysts and decreases the efficiency of photocatalysts. Therefore, there is a strong need to synthesize a nano composite in order to achieve stable photocatalysts for long-time performance.

The major advantage of nano-sized is related to quantum-size effect, which enhance the energy bandgap and reduce the particle size. Moreover, as a process photodegradation also have several advantages such as low cost, reusable, and generally complete degradation. In addition to all of the developments, still nanophotocatalyst facing some issues i.e., toxicity and recovery of catalysts from mixture. These type of issues limits the applications and scope of nanophotocatalyst at higher level. So, the scientific community is now focusing others nanocomposite of different material which can reduce the toxicity while using in water treatment process. So, it is suggestible for the scholar community to synthesize new photocatalysts which can work in visible ranges for sustainable result and promote the doped photocatalyst with different material such as graphene and its derivatives to reduce the toxicity effect. To



overcome the catalyst recovery drawback, one significant approach could be used i.e., magnetic nanophotocatalysts in wastewater treatment. When magnetic nanophotocatalysts are used, the recovery of catalyst can be achieved through external magnetic fields, therefore, permitting the many recycling of nanocatalyst and achieved more effective and naturally responsive water decontamination processes.

A wide research on nanomaterials is ongoing in field of nanophotocatalysis which led to few progress in reactor designing and developments regarding the modifications in nanophotocatalysts. Although many developments in nanophotocatalytic materials occurred, still some important inquiries required related to characteristics of nanophotocatalytic materials. The major challenges in intensification process is mass transfer limitations and higher consumption of photons . The concept of nanocomposites is ideal in solving the electron pair recombination problem which can be prolonged by combining the nanocomposites with nanophotocatalytic reactor structures. The new modern reactors are known as microfluidic reactors which open a new door for intense characteristics study in reaction phase and synthesis phase. Microfluidic reactors are those reactors which are working on micro level with reactants . The key features of micro-reactors are large surface-to-volume ratio, improved diffusion effect and great mass transfer coefficient factor, highly stable hydrodynamics, less Reynold's flow, and informal handling which makes them more ideal material than conventional reactors. However, still it is difficult for photocatalysis to apply on large scale in actual wastewater.

Moreover, the synthesis of significant structures such as nanorod, nanosphere, nanoflowers, nanoflakes and nanocones with enhanced functional and structural properties could be opened an extensive area of study. Several structures of nanomaterials with potential properties could be produced through the measured synthesis approaches. However, the future research, should be explored by producing new photocatalysts. The synthesis of novel nanophotocatalysts with excellent efficiency, inexpensive, eco-friendly and high stability is crucially needed. Moreover, to exploit pollutant treatment effectively, several approaches should be joint with sensible match, such as electrocatalysis, photocatalysis, adsorption and several thermodynamics processes. The preparation of nanocomposites in the presence of ZnO, TiO₂ was well explored in early decades for the treatment of water pollutants. The nanocomposites preparation by using carboneous material, polymer and ceramic materials are still in initial stage. It can generate ideal nanocomposites with improved properties. The heterogeneous photocatalytic for wastewater remediation is inhibited by some main technical problems that need to be study effectively. Finally, a significant photocatalytic treatment with better solar-driven, excellent efficacy and less site area requirements can be comprehended in future with fast assessment.

Implications

Nanotechnology has become one of the most explored technologies of the 21st century. Unique properties of nanomaterials include:

- High surface to volume ratio
- Small size
- Well-organized structure
- Competence of filtration

These properties help the removal of heavy metals from polluted wastewater. Based on the type of nanomaterial, wastewater treatment is divided into three main groups:

1. Nanocatalysts
2. Nano adsorbents
3. Nanomembranes

Nanocatalysts

This treatment involves the photocatalytic activities that include the interaction of light energy with metallic nanoparticles.



The photocatalytic activities destroy microorganisms (bacteria) and organic substances via the reaction with hydroxyl radicals. The materials used in nanocatalysts are typically inorganic materials such as metal oxides and semiconductors.

Nano adsorbents

This treatment utilizes organic or inorganic nanomaterials with a high affinity to adsorb substances. These adsorbents are highly capable of removing many contaminants.

The ideal adsorbent is small, has a large surface area, great catalytic potential, and high reactivity.

Nano-adsorbents are classified based on their adsorption process, i.e., metallic nanoparticle, magnetic nanoparticles, nanostructured mixed oxides, and metallic oxide nanoparticles.

Nanomembranes

In this treatment, nanomembranes can separate pollutants from the wastewater. These are extensively used for the removal of heavy metals, dyes, and other contaminants.

Nanotubes, nanoribbons, and nanofibers are commonly used nanomembranes. Silver nanoparticles are antimicrobial agents that are incorporated during the treatment of wastewater containing high loads of bacterial contaminants.

Silver nanoparticles and graphene oxide nanoparticles play a dual role, i.e., biofouling prevention (disable bacterial cells), and, due to their hydrophilic nature, they can reduce microbial attachment by forming a strong water layer.

Commonly used nanomaterials for industrial water treatment are discussed below:

Carbon nanotubes (CNT): CNTs produce electrically conducting membranes. The pore size of the layer is dependent on the type of polymers used to cross-link the CNT. Membrane pore sizes vary from 100 nm to sub-nanometer. These nanomembranes are extensively used for several biological treatments of industrial wastewater and desalination of industrial brine.

Graphene oxide (GO) nanoparticles: The GO nanoparticles work on the same principle as the transpiration process of a tree leaf, i.e., pulling water through the GO structure while successfully catching solar heat to stimulate the formation of vapor. This technique is used in solar-powered brine desalination.

Fluorinated silica nanoparticles: Fluorinated silica nanoparticles generates a low-energy surface that possesses high resistance to oil. This is immensely useful during the treatment of oil-containing wastewater, oil refining, and food processing industries.

Layered nanomaterials: Layered nanomaterials comprising graphene and graphene oxide, MoS₂, and MXenes (ultrathin transition metal carbonitrides carbides, and nitrides) are used extensively in industrial water treatment.

Mexico-based companies Carbotecnia and Global Proventus offer highly sophisticated equipment for water treatment using different nano-based techniques such as nanofiltration. Heltec manufactures water treatment products based on nanofiltration, microfiltration, ultrafiltration, and electrodeionization. Heltec products are exported to the US, Germany, England, Canada, and Ireland, as well as Central and South America. Aquapro manufactures nanofiltration equipment and provides services such as the installation of equipment of water treatment systems.



Pollution results from resource production and consumption, which in their current state are very wasteful. Most waste cannot be reintegrated into the environment effectively or cheaply. Thus, processes like petroleum and coal extraction, transportation, and consumption continue to result in photochemical smog, acid-mine drainage, oil slicks, acid rain, and fly ash. In his paper for the Foresight Institute, Stephen Gillett identifies the “Promethean Paradigm”: the inefficient dependence on heat for energy since burning fuel discards much of its free energy during the conversion of chemical energy into heat and then to mechanical energy. Biological systems, on the other hand, efficiently oxidize fuel through molecular-scale mechanisms without extracting the chemical energy through thermalization (1). Overcoming the Promethean Paradigm requires controlling reactions at the nanoscale. Thus, nanofabrication holds much potential for effective pollution control, but it currently faces many problems that prevent it from mass commercialization — particularly its high cost.

The basic concept of pollution control on a molecular level is separating specific elements and molecules from a mixture of atoms and molecules (1). The current method for separating atoms is thermal partitioning, which uses heat to force phase changes. However, the preparation of reagents and the procedure itself are costly and inefficient. Current methods of energy extraction utilize combustion to create heat energy, most of which is wasted and results in unwanted byproducts that require purification and proper disposal. Theoretically, these high costs could be solved with the nanostructuring of highly specific catalysts that will be much more efficient (2). Unfortunately, we have yet to find an optimal way of obtaining the particles in workable form. Current means are essentially “shake and bake” methods called wet-chemical synthesis, which allows for very limited control on the final product and may still result in unwanted byproducts (1).

Although there are still many obstacles to overcome, the world is starting to recognize the potential in nanotechnology. In 2007, the Brian Mercer Award for Innovation from the Royal Society was awarded to researchers at the University of Bath for their work in developing nano-porous fibers that trap and remove carbon dioxide along with other pollutants and recycle them back into the production process. These fibers can recycle many forms of gases depending on their composition and the way they are spun (3). The high surface area characteristic of nano-sized particles makes such technology particularly efficient for applications with space constraints. Early tests have shown that this process will require only a small percentage of the energy used by current technology. Along with the award, the United Kingdom also granted £185,000 (\$280,000) for the further development and commercialization of this technology. The hope is to eventually utilize it for pollution control by removing benzene from petrol vapor.

Air

Pollution

Air pollution can be remediated using nanotechnology in several ways. One is through the use of nano-catalysts with increased surface area for gaseous reactions. Catalysts work by speeding up chemical reactions that transform harmful vapors from cars and industrial plants into harmless gases. Catalysts currently in use include a nanofiber catalyst made of manganese oxide that removes volatile organic compounds from industrial smokestacks (4). Other methods are still in development.

Another approach uses nanostructured membranes that have pores small enough to separate methane or carbon dioxide from exhaust (5). John Zhu of the University of Queensland is researching carbon nanotubes (CNT) for trapping greenhouse gas emissions caused by coal mining and power generation. CNT can trap gases up to a hundred times faster than other methods, allowing integration into large-scale industrial plants and power stations. This new technology both processes and separates large volumes of gas effectively, unlike conventional membranes that can only do one or the other effectively. For his work, Zhu received an \$85,000 Foundation Research Excellence Award.

The substances filtered out still presented a problem for disposal, as removing waste from the air only to return it to the ground leaves no net benefits. In 2006, Japanese researchers found a way to collect the soot filtered out of diesel fuel emissions and recycle it into manufacturing material for CNT (6). The diesel soot is used to synthesize the single-walled CNT filter through laser vaporization so that essentially, the filtered waste becomes the filter.

Water

Pollution

As with air pollution, harmful pollutants in water can be converted into harmless chemicals through chemical reactions. Trichloroethene, a dangerous pollutant commonly found in industrial wastewater, can be catalyzed and treated by nanoparticles. Studies have shown that these “materials should be highly suitable as hydrodehalogenation and reduction catalysts for the remediation of various organic and inorganic groundwater contaminants” (7).



Nanotechnology eases the water cleansing process because inserting nanoparticles into underground water sources is cheaper and more efficient than pumping water for treatment (8). The deionization method of using nano-sized fibers as electrodes is not only cheaper, but also more energy efficient (8). Traditional water filtering systems use semi-permeable membranes for electrodialysis or reverse osmosis. Decreasing the pore size of the membrane to the nanometer range would increase the selectivity of the molecules allowed to pass through. Membranes that can even filter out viruses are now available (9).

Also widely used in separation, purification, and decontamination processes are ion exchange resins, which are organic polymer substrate with nano-sized pores on the surface where ions are trapped and exchanged for other ions (10). Ion exchange resins are mostly used for water softening and water purification. In water, poisonous elements like heavy metals are replaced by sodium or potassium. However, ion exchange resins are easily damaged or contaminated by iron, organic matter, bacteria, and chlorine.

Cleaning Up Oil Spills According to the U.S. Environmental Protection Agency (EPA), about 14,000 oil spills are reported each year (11). Dispersing agents, gelling agents and biological agents are most commonly used for cleaning up oil spills.

However, none of these methods can recover the oil lost. Recent developments of nano-wires made of potassium manganese oxide can clean up oil and other organic pollutants while making oil recovery possible (12). These nanowires form a mesh that absorbs up to twenty times its weight in hydrophobic liquids while rejecting water with its water repelling coating. Since the potassium manganese oxide is very stable even at high temperatures, the oil can be boiled off the nanowires and both the oil and the nanowires can then be reused (12).

In 2005, Hurricane Katrina damaged or destroyed more than thirty oil platforms and nine refineries (13). The Interface Science Corporation successfully launched a new oil remediation and recovery application, which used the water repelling nanowires to clean up the oil spilled by the damaged oil platforms and refineries (14).

IV. CONCLUSIONS

In 2009, NanoImpactNet, the European Network on Health and Environmental Nanomaterials will hold its first conference to study the impact of nanomaterials on health and environment. The small size of nanoparticles warrants investigation of the consequences of inhalation and absorption of these particles and their effects inside the body, as they are small enough to penetrate the skin and diffuse through cell membranes. The special properties of nanoparticles inside the body are unclear and unpredictable. Also, many are worried about the effects of nanoparticles on the environment. New branches of science such as eco-nanotoxicology have arisen to study the movement of nanomaterials through the biosphere. We do not yet know how much will be absorbed by the soil, air, or water, and how severely the widespread presence of nanoparticles in the environment will impact the ecosystem. To address these concerns, NanoImpactNet aims to set up regulations and legislation to ensure that nanoparticles, with so much potential for cleaning up pollution, will not become a new form of pollution themselves. Nanotechnology's potential and promise have steadily been growing throughout the years. The world is quickly accepting and adapting to this new addition to the scientific toolbox. Although there are many obstacles to overcome in implementing this technology for common usage, science is constantly refining, developing, and making breakthroughs.[14]

REFERENCES

1. S. L. Gillett, Nanotechnology: Clean Energy and Resources for the Future (2002). Available at http://www.foresight.org/impact/whitepaper_illos_rev3.PDF (5 January 2009)
2. S.L. Gillett, Nanotechnology. 7, 177-182 (1996)
3. A. McLaughlin, Pollution control technology wins Royal Society award (20 February 2007). Available at <http://www.bath.ac.uk/news/2007/2/20/merceraaward.html> (29 November 2008)
4. Air Pollution and Nanotechnology. Available at <http://www.understandingnano.com/air.html> (18 December 2008)
5. J. Zhu, Dr John Zhu, School of Engineering (19 September 2007). Available at <http://www.uq.edu.au/research/index.html?page=68941&pid=68941> (15 December 2008)
6. T. Uchida et al., Japanese Journal of Applied Physics 45, 8027-8029 (2006).
7. M.O. Nutt, J.B. Hughes, M.S. Wong, Environmental Science & Technology 39, 1346-1353 (2005).



8. Water Pollution and Nanotechnology. Available at <http://www.understandingnano.com/water.html> (17 December 2008).
9. F. Tepper, L. Kaledin, Virus and Protein Separation Using Nano Alumina Fiber Media. Available at <http://www.argonide.com/Paper%20PREP%2007-final.pdf> (5 January 2009)
10. D. Alchin, Ion Exchange Resins. Available at <http://www.nzic.org.nz/ChemProcesses/water/13D.pdf> (18 December 2008)
11. U.S. Environmental Protection Agency, Response to Oil Spills (18 September 2008). Available at <http://www.epa.gov/emergencies/content/learning/response.htm> (31 December 2008)
12. J. Yuan et al., Nature Nanotechnology 3, 332-336 (2008).
13. United States Department of Commerce, Hurricane Katrina Service Assessment Report. (June 2006). Available at <http://www.weather.gov/os/assessments/pdfs/Katrina.pdf> (17 December 2008).
14. B. Lamba, Nanotechnology for recovery and reuse of spilled oil. (9 September 2005). Available at <http://www.physorg.com/news6358.html> (10 December 2008).



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