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Development of Nanosensors in Nuclear Waste Water

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Abstract

Studying the bonding nature of uranyl and Plutonyl ion and graphene oxide (GO) is very important for understanding the mechanism of the removal of uranium from radioactive waste water with GO-based materials, lead to the principle of nuclear nanosensor. This article highlights the work of nanosensors in dealing with nuclear waste water discovered by interaction of Graphene and Graphene oxide with uranium and plutonium and their complex.

Keywords: Nuclear energy; Graphene oxide (GO); Radioactive Materials; Uranium; Plutonium

Introduction

As the theme of this article, I have chosen the words by Richard Feynman: "I will not now discuss how we are going to do it, but only what is possible in principle - in other words, what is possible according to the laws of physics" [1]. Just after Christmas 1959, he delivered a now-famous talk – titled "There's Plenty of Room at the Bottom" - at the California Institute of Technology. It is possible, he proposed, for scientists to assemble new materials at the level of single atoms and molecules, where there are "new kinds of forces and new kinds of possibilities, new kinds of effects". It is generally accepted that Feynman's visionary discussion of the problems and promise of miniaturization constituted the starting point for the new field that today is called Nanotechnology.

With the rapid development of Nuclear energy, radioactive wastewater has become of major concern and environmental challenge throughout the world; Uranium and Plutonium are the naturally occurred elements in nuclear energy programs. In the meanwhile, large amounts of Uranium have been inevitably released into the environment which would cause serious health problems due to its extremely chemical and radioactive toxicity [2]. Uranium and Plutonium ions and their complexes play an important role in nuclear fuel reprocessing, and their trace characterization is important in nuclear forensics. Uranium and Plutonium oxides and their complexes are major Constituents present in soils and groundwater around contaminated sites, as well as, near production facilities [2-4].

Dissolved Uranium is predominantly present in the form of Uranyl (VI) complexes. 1 Plutonium is known to exist in aqueous solution in four different oxidation states, III, IV, V, and VI, with the last two as the dioxo-species $PuO^{2+}$and $PuO2^{2+}$ [5]. The Uranyl ion in aqueous phase is reported to form pentagonal bipyramidal structure with five water molecules lying in equatorial plane. In the presence of counterions (CO_3^{2-}, OH^-, and NO^{3-}), one or two water molecules in the first shell are replaced by the counterions preserving five-fold symmetry. Unlike uranyl ions, U^{3+}, Pu^{3+}, and Pu^{4+} form coordination with water molecules [6,7]. There is a strong electron transfer observed, and counterions are strongly bonded to the central actinide ion. The contamination of groundwater due to accidental leakage of radioactive wastes poses a grave danger to the environment and human life. Hence, trace characterization of these radioactive materials is essential in nuclear forensics. The design and fabrication of electronic molecular devices as sensors for Plutonium