CHEMISTRY DEPARTMENT SEMINAR

Applications of ^{238}Pu are Out of this World

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The first isotope of plutonium to be discovered was ^{238}Pu, produced in 1940 by bombarding uranium with deuterons. Its short half-life (87.7 yr) was conducive to tracer studies that allowed its separation and identification. Today, ^{238}Pu is readily obtained by neutron bombardment of ^{237}Np, and separated by solvent extraction techniques.

^{238}Pu has found important application in radioisotope power systems – nuclear power systems that derive their energy from the heat produced by spontaneous decay, as distinguished from nuclear fission. Most radioisotope power systems use ^{238}Pu as an isotope heat source. I will present an overview of the production, purification, component fabrication, applications, and disposal of this very important isotope.

By far, the most prevalent application has been for space and interplanetary exploration. For this application, heat source fuel is enriched to 83.5% in ^{238}Pu isotope, and oxygen atoms in $^{238}PuO_2$ are enriched in ^{16}O to reduce the neutron emission rate to as low as 6000 n/s/g. The ^{238}Pu isotope provides 99.9% of the thermal power in heat source fuel. Radioisotope Thermoelectric Generators (RTGs) have been used in the United States to provide electrical power for spacecraft since 1961 in Space Nuclear Auxiliary Power (SNAP) units to power satellites and remote instrument packages on the moon. The current systems employ General Purpose Heat Sources (GPHS) of hot pressed 150 g pellets of $^{238}PuO_2$. These have found widespread application as power sources for exploration of the planets through satellite probes such as Galileo (Jupiter), Cassini (Saturn), and New Horizons (Pluto), and more recently, to power instrumentation on a series of Mars Rovers (Figure). The use of ^{238}Pu in future NASA space missions will be

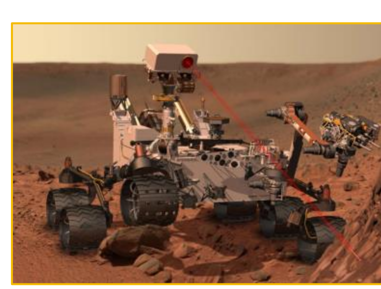

Figure: The Curiosity Mars Rover was the first to use a Multi Mission Radioisotope Thermoelectric Generator (MMRTG)

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