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Radium (Ra^{88})

Properties

Radium is a silvery-white, soft and is the heaviest known alkaline earth metal. It is also the only radioactive member of its group. Its physical and chemical properties most closely resemble its lighter congener barium. It has an atomic mass of 226 amu and is naturally radioactive. It has a density of 5.5 g/cm^3, a melting point of 700 ^{o}C and a resistivity of ~100 μΩ cm.

Radium is very reactive and readily reacts with nitrogen in air to form Ra_3N_2. Because of its reactivity, the free metal does not occur in nature, but its compounds occurs naturally in uranium ores.[1] The pure metal is produced by electrolysis as a biproduct in uranium extraction. The most common oxidation state for Radium is +2. It is generally more reactive than any other elements in group II. Radium metal is highly reducing, with the standard reduction potential for the Ra^{2+}/Ra couple being −2.8V. Because of its relative longevity, ^{226}Ra is the most common isotope of the element, making up about one part per trillion (ppt) of the Earth's crust.

Plating Solutions

Radium is similar to other alkaline earth metals and difficult to deposit electrochemically. Radium chloride or bromide can be dissolved in 1 M solution of nitric acid and be used as a reagent for Ra plating in the following solution: 0.3 M solution of radium salt and the pH was adjusted to 9 using ammonium acetate at a current density of 10 mA/cm^2 and at 60 °C [2].

Applications

Radium once was used in a lot of applications from food additives to medicine. It used to be added to toothpastes, hair creams and even food products before being banned because of its side effects [3]. Nowadays it has applications in medicine and cancer therapy as a contrasting agent. Some of the few practical uses of radium are derived from its radioactive properties. For example, the isotope ^{223}Ra was approved by the United States Food and Drug Administration in 2013 for use in medicine as a cancer treatment of bone metastasis.[4]

References:

[1] R. F. Mould, “Marie and Pierre Curie and radium: History, mystery, and discovery,” *Med. Phys.* **26**(9), 1766-1172, 1999.
[2] D. Roman, “Electrodeposition of radium on stainless steel from aqueous solutions,” *Int. J. Appl. Radiat. Isot.* **35**(10), 990-992, 1984.
[3] E. John, “An A-Z Guide to The Elements,” *Oxford Univ. Press*, 2001.
[4] A. S. Malamas, S. R. Gameiro, K. M. Knudson, and J. W. Hodge, “Sublethal exposure to alpha radiation (^{223}Ra dichloride) enhances various carcinomas' sensitivity to lysis by antigen-specific cytotoxic T lymphocytes through calreticulin-mediated immunogenic modulation,” *Oncotarget* **7**(52), 86937-86947, 2016.

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