NANO3D SYSTEMS LLC
1110 NE Circle Blvd., ATAMI/Bldg. 11, Corvallis, Oregon 97330-4254
T 503-927-4766| F 541-758-9320| http://www.nano3dsystems.com

Technetium (Tc^{43})

Properties

Technetium is a silvery-gray transition metal with an atomic mass of 97 u. It has a density of 11 g/cm^3, a melting point of 2157 ^oC and a resistivity of 20 μOhm cm. Technetium is he lightest element whose isotopes are all radioactive; non are stable, excluding the fully ionized state of ^{97}Tc.

Technetium exhibits nine oxidation states from −1 to +7, with +4, +5, and +7 being the most common. Technetium dissolves in aqua regia, nitric acid, and concentrated sulfuric acid, but it is not soluble in hydrochloric acid of any concentration. Standard reduction potential $TcO^-_4 + 4H_2O + 7e^- = Tc(s) + 8OH^-$ is -0.474V. Technetium occurs naturally in the Earth's crust in minute concentrations of about 0.003 parts per trillion (ppt).

Plating Solutions

Technetium can be electrodeposited from aqueous electrolytes, containing sodium/ammonium pertechnetate and sulfuric acid [1], formate buffer solution with pH 6.0-7.5 [2], urea oxalate bath [3] and others.

Pertechnetate stabilizing agents can be also used in the plating baths, including oxalic acid, citric acid, tartaric acid, glutaric, malonic, succinic, and ammonium salts. Stabilizing agents prevents reduction of pertechnetate to lower valence state that prevents the precipitation in the plating solution at room temperature and pH 1-2 [4].

Applications

Technetium-99m ("m" indicates that this is a metastable nuclear isomer) is the most widely isotope for medical nuclear imaging. The chemistry of technetium allows it to be bound to a variety of biochemical compounds, each of which determines how it is metabolized and deposited in the body, and this single isotope can be used for a multitude of diagnostic tests. More than 50 common radiopharmaceuticals are based on technetium-99m for imaging and functional studies of the brain, heart muscle, thyroid, lungs, liver, gall bladder, kidneys, skeleton, blood, and tumors.

References:

1. M.D. Engelmann et al. *Journal of Radioanalytical and Nuclear Chemistry* **276**(2), 493-498, 2008.
2. A. Maslennikov and V. Peretroukhine. *Radoichimica Acta* **83**(11), 31-37, 1998.
3. A.T. Rane and K.S. Bhatki. *The International Journal of Applied Radiation and Isotopes* **24**(7), 385-389, 1973.
4. W.D. Box. *US Patent 3,374,157.* Patented Mar. 19, 1968.

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