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Bulk francium has never been viewed. Because of the general appearance of the other elements in its periodic table column, it is assumed that francium would appear as a highly reactive metal, if enough could be collected together to be viewed as a bulk solid or liquid. Obtaining such a sample is highly improbable, since the extreme heat of decay (the half-life of its longest-lived isotope is only 22 minutes) would immediately vaporize any viewable quantity of the element.

Characteristics

Francium is one of the most unstable of the naturally occurring elements: its longest-lived isotope, francium-223, has a half-life of only 22 minutes. The only comparable element is astatine, whose most stable *natural* isotope, astatine-219 (the alpha daughter of francium-223), has a half-life of 56 seconds, although synthetic astatine-210 is much longer-lived with a half-life of 8.1 hours.^[4] All isotopes of francium decay into astatine, radium, or radon.^[4] Francium-223 also has a shorter half-life than the longest-lived isotope of each synthetic element up to and including element 105, dubnium.^[5]

General properties

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Francium is an alkali metal whose chemical properties mostly resemble those of caesium.^[5] A heavy element with a single valence electron,^[6] it has the highest equivalent weight of any element.^[5] Liquid francium—if created—should have a surface tension of 0.05092 N/m at its melting point.^[7] Francium's melting point was calculated to be around 27 °C (80 °F, 300 K).^[8] The melting point is uncertain because of the element's extreme rarity and radioactivity. Thus, the estimated boiling point value of 677 °C (1250 °F, 950 K) is also uncertain.

Linus Pauling estimated the electronegativity of francium at 0.7 on the Pauling scale, the same as caesium;^[9] the value for caesium has since been refined to 0.79, but there are no experimental data to allow a refinement of the value for francium.^[10]

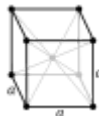
Francium has a slightly higher ionization energy than caesium,^[11] 392.811(4) kJ/mol as opposed to 375.7041(2) kJ/mol for caesium, as would be expected from relativistic effects, and this would imply that caesium is the less electronegative of the two.

Francium should also have a higher electron affinity than caesium and the Fr[−] ion should be more polarizable than the Cs[−] ion.^[12] The CsFr molecule is predicted to have francium at the negative end of the dipole, unlike all known heterodiatomic alkali metal molecules. Francium superoxide (FrO₂) is expected to have a more covalent character than its lighter congeners; this is attributed to the 6p electrons in francium being more involved in the francium–oxygen bonding.^[12]

Francium coprecipitates with several caesium salts, such as caesium perchlorate, which results in small amounts of francium perchlorate. This coprecipitation can be used to isolate francium, by adapting the radiocaesium coprecipitation method of Glendenin and Nelson. It will additionally coprecipitate with many other caesium salts, including the iodate, the picrate, the tartrate (also rubidium tartrate), the chloroplatinate, and the silicotungstate. It also coprecipitates with silicotungstic acid, and with perchloric acid, without another alkali metal as a carrier, which provides other methods of separation.^{[13][14]} Nearly all francium salts are water-soluble.^[15]

Isotopes

Atomic properties					
Oxidation states	+1 (a strongly basic oxide)				
Electronegativity	Pauling scale: >0.79				
Ionization energies	1st: 393 ^[2] kJ/mol				
Covalent radius	260 pm (<i>extrapolated</i>)				
Van der Waals radius	348 pm (<i>extrapolated</i>)				
Miscellanea					
Crystal structure	body-centered cubic (bcc) (<i>extrapolated</i>)				
Thermal conductivity	15 W/(m·K) (<i>extrapolated</i>)				
Electrical resistivity	3 μΩ·m (<i>calculated</i>)				
Magnetic ordering	Paramagnetic				
CAS Number	7440-73-5				
History					
Naming	after France, homeland of the discoverer				
Discovery and first isolation	Marguerite Perey (1939)				
Most stable isotopes of francium					
iso	NA	half-life	DM	DE (MeV)	DP
²²¹ Fr	trace	4.8 min	α	6.457	²¹⁷ At
²²² Fr	syn	14.2 min	β [−]	2.033	²²² Ra
²²³ Fr	trace	22.00 min	β [−]	1.149	²²³ Ra
			α	5.430	²¹⁹ At



There are 34 known isotopes of francium ranging in atomic mass from 199 to 232.^[16]

Francium has seven metastable nuclear isomers.^[5] Francium-223 and francium-221 are the only isotopes that occur in nature, though the former is far more common.^[17]

Francium-223 is the most stable isotope, with a half-life of 21.8 minutes,^[5] and it is highly unlikely that an isotope of francium with a longer half-life will ever be discovered or synthesized.^[18] Francium-223 is the fifth product of the actinium decay series as the daughter isotope of actinium-227.^[19] Francium-223 then decays into radium-223 by beta decay (1149 keV decay energy), with a minor (0.006%) alpha decay path to astatine-219 (5.4 MeV decay energy).^[20]

Francium-221 has a half-life of 4.8 minutes.^[5] It is the ninth product of the neptunium decay series as a daughter isotope of actinium-225.^[19] Francium-221 then decays into astatine-217 by alpha decay (6.457 MeV decay energy).^[5]

The least stable ground state isotope is francium-215, with a half-life of 0.12 μ s. (9.54 MeV alpha decay to astatine-211):^[5] Its metastable isomer, francium-215m, is less stable still, with a half-life of only 3.5 ns.^[21]

Source

- Wikipedia: Francium (<https://en.wikipedia.org/wiki/Francium>)