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PLUTONIUM CLEANING PROCESS

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This invention relates to a method of preparing clean, passive metal surfaces and more particularly to a method of preparing clean plutonium surfaces and rendering these surfaces passive.

Plutonium metal in its many uses in nuclear systems is required to be substantially pure and clean. Methods have been developed for accomplishing these requirements. However, plutonium, or plutonium alloys, or plutonium metal compacts containing a major proportion by weight plutonium are very reactive and even when obtained with a clean surface tend to oxidize rapidly. The surface is then not only impure, but also in a dangerous condition because the oxide tends to dust off as a toxic radioactive powder. Consequently, it is usually necessary to keep the surface out of contact with air or moisture either by control of the atmosphere or by metal coating. Furthermore, it often becomes necessary to remove these metal coatings in order to rework the plutonium metal compositions. It is desirable at such times to remove the film without removing any of the very expensive plutonium.

Prior to the time of this invention all attempts to clean, for example, to remove a metal coating, by simply immersing the coated object in chemical solutions were considered unsatisfactory because the valuable plutonium was also dissolved. Even if the amount of plutonium dissolved could be reduced to a minimum these methods render the cleaned plutonium very active and thus it is rapidly oxidized. A method which will remove oxide layers, metal coatings, or other impurities and at the same time render the plutonium passive is thus very desirable.

It is, therefore, the primary object of this invention to provide a simple, efficient method for cleaning plutonium metal compositions.

It is another object of this invention to provide a method for removing metal coatings from plutonium, or plutonium alloys, or plutonium metal compacts containing a major proportion by weight plutonium, which at the same time renders the plutonium metal passive.

It is a further object of this invention to provide a method for rendering the surfaces of a plutonium metal composition passive so that the plutonium may be stored as pure uncoated plutonium for a short period of time.

The objects of this invention are achieved by immersing the plutonium metal composition in an acid solution containing a substantial concentration of nitrate ions.

The method of this invention is best illustrated by the following example in which is presented the presently preferred embodiment. This example is given for the purpose of illustration only and not for the purpose of limiting the spirit or scope of this invention.

Example I

A block of plutonium 1 inch by 1 inch by ½ inch completely enclosed by a 2 mil nickel coating, is degreased by immersion in carbon tetrachloride. It is then placed in a dry box in a Pyrex container containing 200 cubic centimeters of fuming nitric acid. The plutonium object is permitted to stand in the fuming nitric for one hour. At intervals the plutonium is vigorously stirred in the fuming acid. The plutonium is removed from the acid every ten minutes and brushed with a stiff brush to remove the oxide film which tends to form on its surfaces. When the nickel coating is removed, the plutonium surface is made passive. The clean plutonium object is removed from the bath and is thoroughly washed in water and with acetone to dry. The surfaces of the plutonium are clean, bright, lustrous, but passive. It is then used or placed in storage in a dry, cool atmosphere.

The concentration of the nitrate ions used to remove the metal coatings and passify the plutonium surface may be varied. This is illustrated in the following example which is given for this purpose only.

Example II

A ½ inch cubic block of plutonium covered with 3 mils of iron is degreased by immersion in acetone. It is then immersed in 200 cubic centimeters of an aqueous solution containing equal parts by volume of concentrated nitric acid and water in a Pyrex beaker in a well ventilated dry box. The iron rapidly dissolves in about one minute and the plutonium is clean, bright, lustrous, but passive. It is then rinsed with water and is placed in an argon atmosphere until it is needed.

The nitrate ions need not be introduced by nitric acid, but may be introduced, for example, by a salt such as ammonium nitrate in phosphoric acid. Although it is preferable to first clean the plutonium block such as by immersion in a solvent, this is not necessary. One such embodiment is presented in the following example.

Example III

A block of plutonium 1 inch by 1 inch by ½ inch which has been coated with a 3 mil coating of zinc, is placed in a stainless steel dish containing 125 grams of ammonium nitrate in 200 cubic centimeters of concentrated phosphoric acid. The zinc dissolves rapidly and when the evolution of gas ceases, the plutonium is removed from the bath and is successively washed in water and acetone. The plutonium is clean, bright, lustrous, but passive. It is placed in a cool, dry atmosphere until it is needed.

Other combinations of nitrate salts and acids can be used, including various mixtures of sodium nitrate, potassium nitrate, lithium nitrate, nitric acid and sulfuric acid as well as the ammonium nitrate and phosphoric acid. However, there should not be a material concentration of halide ions.

The method of this invention may also be applied to the surfaces of plutonium metal compositions which are not covered with a metal coating but which have other materials on the surface. Furthermore, it may be used to make the surface of the plutonium metal compositions passive when the surface has been cleaned by other methods. For example, a plutonium metal composition which has just been machined may be rendered passive by immersion in a solution containing one part of nitric acid in 20 parts of water.

The process may also be varied by making the plutonium metal composition anodic in the nitrate solution, but this is not a preferred embodiment.

The method of the invention can also be varied in many ways. For example, the container need not be of Pyrex glass or stainless steel, but may be of any material which is not appreciably soluble in an acid solution containing nitrate ions. As pointed out hereinbefore, the concentration of the nitrate ions may also be varied considerably.

It is to be understood that when plutonium metal com-

positions are mentioned in the specification or in the claims, pure plutonium, or plutonium alloys or plutonium metal compacts containing a major proportion by weight plutonium are meant.

Attention is invited to applicant's co-pending patent application Serial No. 23,865, filed April 28, 1948.

Because there are many possible embodiments of the method of this invention, it is to be understood this invention is not to be limited except as indicated in the appended claims.

What is claimed is:

1. A method of treating metal coated plutonium metal compositions to remove the metal coating only therefrom, said coating being selected from the class consisting of iron, nickel and zinc, which comprises immersing a metal coated plutonium metal composition in an aqueous acid solution containing a substantial concentration of nitrate ions for a period of time sufficient to dissolve the metal coating from said plutonium metal composition and withdrawing said plutonium metal composition from said aqueous acid solution.

2. A method of treating metal coated plutonium metal compositions to remove the metal coating only therefrom, said coating being selected from the class consisting of iron, nickel and zinc, which comprises immersing a metal coated plutonium metal composition in a concentrated nitric acid for a period of time sufficient to dissolve the metal coating from said plutonium metal composition and withdrawing said plutonium metal composition from said nitric acid.

3. A method of treating metal coated plutonium metal compositions to remove the metal coating only therefrom, said coating being selected from the class consisting of iron, nickel and zinc, which comprises immersing a metal coated plutonium metal composition in fuming nitric acid until the metal coating is dissolved from said plutonium metal composition and withdrawing said plutonium metal composition from said fuming nitric acid.

4. A method of treating metal coated plutonium metal compositions to remove the metal coating only therefrom, said coating being selected from the class consisting of iron, nickel and zinc, which comprises immersing a metal coated plutonium metal composition in dilute nitric acid solution for a period of time sufficient to dissolve the metal coating from said plutonium metal composition and to passify the uncoated plutonium metal composition, and withdrawing said plutonium metal composition from said dilute nitric acid solution.

5. A method of treating metal coated plutonium metal compositions to remove the metal coating only therefrom, said coating being selected from the class consisting of iron, nickel and zinc, which comprises degreasing the metal coated metal composition in an organic solvent, and contacting the degreased, metal coated composition with an aqueous acid solution containing a substantial concentration of nitrate ions for a period of time sufficient to dissolve the metal coating and to passify the uncoated plutonium metal composition and withdrawing said plutonium metal composition from said aqueous acid solution.

6. The process for the selective removal of a metal coating only from a plutonium metal composition, said coating being selected from the class consisting of iron, nickel and zinc, which comprises contacting a metal coated plutonium metal composition with a solution containing a nitrate and phosphoric acid for a period of time sufficient to dissolve the metal coating and to passify the uncoated plutonium metal composition and withdrawing said plutonium metal composition from said solution.

7. A process for the selective removal of a metal coating material only from a plutonium metal composition which comprises contacting a metal coated plutonium metal composition, wherein said metal coating is selected from the class consisting of iron, nickel and zinc, with a concentrated phosphoric acid solution containing from 500 to 800 grams per liter of ammonium nitrate until the metal coating material is dissolved from the plutonium metal composition and until said uncoated plutonium metal composition is rendered passive and withdrawing said plutonium metal composition from said solution.

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