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METHOD OF TREATING POLONIUM PLATED METAL

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This invention relates to the art of plating polonium and relates especially to a method of removing surface impurities from a metal plated with polonium.

Polonium is a radioactive metal classified in the uranium-radium family of radioactive elements. It has a half-life period of about 138 days and is a powerful emitter of strong alpha rays. It emits practically no beta rays or gamma rays, and, during the course of its relatively short life it gradually changes directly into an inactive isotope of lead. By virtue of its unique properties polonium is utilized, both scientifically and commercially, as a convenient and efficient agent for ionizing gases. An example of an important commercial use of polonium is the incorporation of an extremely small amount of the metal in an internal combustion engine spark plug near the spark gap thereof for the purpose of substantially improving the sparking characteristics of the plug.

Polonium occurs in commercially significant quantities in radio-lead compounds which are a by-product of the radium refining industry. Radio-lead consists mainly of lead, but contains small amounts of radium D and polonium. The usual commercial process of isolating polonium comprises forming a solution of a soluble salt, preferably the chloride, of radio-lead and then plating the polonium from this solution onto another metal. Electroplating with applied voltage is not necessary, as the polonium will plate onto most other metals by adsorption or chemical displacement. According to a preferred procedure polonium is plated by chemical displacement from a hot solution of radio-lead chloride onto nickel foils. The plated nickel foils may be used directly, melted with or without the addition of other metal to form a polonium alloy, or treated to drive off the free polonium (e. g., by vaporization) so that it may thereafter be isolated in a more concentrated form.

The radio-lead chloride for the plating solution is generally prepared by treating radio-lead oxide with hydrochloric acid. The resulting lead chloride solution contains small amounts of impurities, chief of which is bismuth compounds and finely divided, suspended, unconverted lead oxide; iron and copper are also occasionally present. These impurities, particularly the bismuth and lead oxide, are co-deposited with the polonium on the foil to a degree which appreciably affects the usefulness of the plated foil. Primarily, these impurities prevent requisite adhesion of the deposit to the foil and permit the deposit to frac-

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ture and break away when the plated foil is cut, bent, or otherwise manipulated. Secondly, as the principal commercial utility of a polonium plated foil at the present time is its introduction into spark plug electrodes, it is desirable not to introduce these impurities into the nickel-manganese-silicon alloy from which the spark plug electrodes wires are drawn. Fractional percentages of bismuth and/or lead in nickel alloys have deleterious effects on the physical properties of the alloy. For instance, as little as 0.005% of bismuth will have a noticeable effect on the physical properties of a nickel alloy. The usual practice in removing the said impurities has been to dip the freshly plated foils momentarily in a cleansing solution of approximately 35% nitric acid solution at room temperature, thereafter rinsing promptly in water. This procedure, though successful in removing the impurities, must be executed with considerable skill and speed or a significant portion of the polonium is removed. With foil on which the percentage of impurities in the deposit is unusually high, complete removal of the polonium may accompany obtaining of the necessary degree of cleanliness.

It is an object of this invention, therefore, to remove impurities from a polonium containing deposit on metal foil without measurably reducing the polonium concentration on the foil. It is also an object to obtain greater yields of polonium from the polonium plating process than have heretofore been obtained, through the reduction of the amount of polonium lost through discarded cleansing solutions. Another object is to provide a method less sensitive and more operable by unskilled personnel. Other objects will become apparent as the invention is described.

This invention comprises broadly the removing of surface impurities from a polonium plated metal by means of a solution containing ammonium hydroxide and ammonium persulfate. This solution is used in place of the nitric acid solution heretofore used. In the experience of the inventor, the optimum solution presently indicated, contains in the neighborhood of 7 to 8% by weight of ammonium hydroxide and 4 to 5% by weight of ammonium persulfate. A solution of this character may be prepared by mixing one part of 26° Baumé commercial aqua ammonia (about 29% ammonia solution) and one part of ammonium persulfate solution (6 ounces of ammonium persulfate to the gallon of water) with 3 parts of water.

Immersion of plated foil in this solution at

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room temperature causes dissolution of the surface impurities in a matter of seconds while the polonium itself is not appreciably affected in 10 to 15 minutes. Time, within these approximate limits, and temperature are, therefore, not critical. The operator is relieved of the haste and precision which is involved in the nitric acid process. In the latter process some sacrifice of polonium is usually entailed and is approximately proportional to the time of immersion. The operator, therefore, in the nitric acid process is continually confronted with the decision of whether he should again immerse the foil to remove the remaining traces of impurities and sacrifice still more polonium. In employing the solution of the present invention, dipping of the foil can be prolonged or repeated until the desired results are obtained.

Example

The cleansing solution herein prescribed may be successfully employed if the following procedure is observed. At the conclusion of the plating cycle the source of heat is removed and the plating solution is chilled. The polonium plated nickel foils are left in the plating solution during this cooling process, usually until the following day. The operator then removes the foils individually giving each a swish in the plating solution to mechanically remove the adhering crystals of radio-lead chloride. The foils are thereafter suspended in a tank of fresh running water for at least 10 minutes to remove all traces of the water soluble radio-lead chloride. Handling each foil separately, they are now immersed for a few seconds (usually 10 or 15 seconds are sufficient) in the ammonium persulfate dipping solution, at room temperature. The foils are again suspended in fresh running water to remove the adhering bright dip solution. Foils are hung in the air to drain and dry. If on drying, any or all of the foils show areas of discoloration indicating impurities, the dipping procedure just described may be repeated. When the appearance of the deposit on the foil is satisfactory, it is either returned to the plating solution for a further coating of polonium plate, or if the requisite

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thickness of polonium, as indicated by a known method of measuring alpha ray emission, has been obtained, the foils may be packaged for shipment to an alloy manufacturer.

The selective action of the ammonium persulfate solution herein recommended renders it more suitable than any known method of surface impurity removal for the commercial production of polonium plated metal foil, in that, preciseness as to timing has been made unnecessary and the operation may be trusted to relatively unskilled personnel. Moreover, as the solubility of the polonium in the said solution is low, greater yields of metal plated foil are now obtainable from plating solutions than formerly.

Modification may be resorted to and proportions varied without departing from the scope and spirit of the invention as set forth in the following claims.

What is claimed is:

1. The method of removing surface impurities including lead and bismuth compounds from polonium-plated metal which comprises treating the plated metal at room temperature with an aqueous solution containing ammonium hydroxide and ammonium persulfate for a length of time not over fifteen minutes.

2. The method of removing surface impurities including lead and bismuth compounds from polonium-plated metal which comprises treating the plated metal at room temperature with an aqueous solution containing 7 to 8% by weight of ammonium hydroxide and 4 to 5% by weight of ammonium persulfate for a length of time not over fifteen minutes.

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