

[54] **PLATINUM-CONTAINING X-RAY
TARGET**

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[57] **ABSTRACT**

This invention relates to alloys useful in X-ray targets comprising tungsten and platinum.

9 Claims, No Drawings

PLATINUM-CONTAINING X-RAY TARGET

X-ray equipment is in wide use for a variety of purposes. Various means are employed to bombard electrons onto a positively charged surface which is conveniently referred to either as an anode or as an X-ray target. There are various types of targets available on the market. These include stationary targets and rotating targets. In general, the X-rays are produced when the electrons hit the surface of the anode or target under appropriate X-ray generating conditions.

The portion of the surface of the target that is bombarded by electrons can be referred to as the focal track.

The material of which the target surface area or focal track is produced is quite important. The material must be of the proper type to both withstand the temperatures of operation and to be an X-ray emitter of sufficient intensity. In addition, the material must have sufficient ductility to withstand conditions of repeated operation. One of the problems frequently encountered with X-ray targets is the roughening of the surface thereby diminishing the efficiency of X-ray emission and rendering emission erratic.

Tungsten is a material commonly used in X-ray targets either alone or as an alloy with small amounts of rhenium. The addition of other refractory metals such as osmium and iridium has also been suggested and used for improving the properties of tungsten targets.

The present invention involves the discovery that the alloying of a small quantity of platinum metal with tungsten yields vast and unexpected advantages to tungsten X-ray targets. Even very small quantities of platinum, i.e., on the order of several tenths of one per cent by weight, when alloyed with tungsten, produce X-ray targets that are characterized by an unusually long service life. The primary improvement is that much less roughening of the surface occurs with the platinum-tungsten alloy upon exposure to service as compared to tungsten alone. X-ray targets made of a tungsten-rhenium alloy are particularly satisfactory for use and they, too, are improved in the same fashion by the addition of a small quantity of platinum. Also improved by the addition of a small quantity of platinum are X-ray targets made of tungsten and one or both of osmium and iridium with or without rhenium.

The effect of this invention was not expected because platinum has a relatively low melting point and might be expected to be adversely affected by the temperatures of X-ray emission experienced in service. It appears, however, that platinum has the opposite effect of what might have been expected and yields a radical improvement to the tungsten surface.

As is the case in known X-ray targets, for example, in rotating targets, the entire target need not be made of the tungsten-platinum alloy but, instead, the target can be a composite of a base having applied thereon a focal track, i.e., a surface for bombardment of electrons, made of the tungsten-platinum alloy. Molybdenum is a suitable material for a base of this type. Other bases may also be employed as is conventional in the art. For example, the base may be made of graphite. However, where a graphite base is employed, there should be an intermediate layer between the graphite and the tungsten alloy for the purpose of preventing the formation of the brittle tungsten carbide. A suitable intermediate layer can be made of such materials as, for example, rhenium or osmium. Such an intermediate layer should have a thickness on the order of 2 to 10 microns.

Where a composite X-ray target is employed made of a base and a focal track of the tungsten alloy of this invention, the total thickness of the tungsten alloy layer in the focal track should be between about 0.1 mm and 2 mm.

A typical rotating X-ray target of the type that could be used in commercial X-ray tubes will have a molybdenum base of approximately 6 mm thickness and a focal track of the tungsten alloy of this invention of approximately 1.2 mm thickness.

The amount of platinum employed in the tungsten alloy of this invention need not be very great. The platinum content of the tungsten alloy may be as low as about 0.05 percent by weight. Generally, the use of more than about 5 percent by

weight of platinum in the alloy is not recommended. The best results are generally achieved when the tungsten-platinum alloy contains from about 0.15 to about 1.5 percent by weight of platinum.

The platinum-tungsten alloys of the invention can also contain up to about 10 percent rhenium for the purpose of improving physical properties such as, for example, the cold ductility of the alloy. Where rhenium is employed, the minimum amount of rhenium to have an appreciable effect should be at least about 0.5 percent by weight of the alloy. Similarly, where desired, amounts of up to 5 percent osmium and up to 2 percent iridium by weight can be present in the alloy of this invention for the purpose of improving target performance. Where osmium is employed, a minimum of about 0.1 percent by weight can be used and where iridium is employed, a minimum of about 0.05 percent by weight can be used.

The method of producing the alloy of the invention is conveniently carried out by powder metallurgical techniques. For example, powders of the various alloy components can be mixed together, compressed and sintered under vacuum or inert atmosphere at an appropriate sintering temperature to cause alloy formation. The sintering temperature will generally be in the range of from about 1,600° to 2,400° C. Alternatively, the tungsten-platinum alloy can be first formed by any conventional technique and applied to the base of the target by spraying, by vapor deposition or by any other method that is convenient.

Where tungsten powder is desired for use in a powder metallurgical system, it can be obtained conveniently by reducing a mixture of a powdered tungsten compound such as tungsten trioxide or ammonium tungstate. The platinum powder can be conveniently obtained by reducing a powdered platinum compound such as platinumous chloride or ammonium chloroplatinate. In general, powders employed can have particle sizes in the range of 1 to 50 microns.

A convenient target for use in an X-ray tube can be made, for example, by preparing a die and filling it to the predetermined level with molybdenum powder of particle size range 2 to 10 microns, i.e., where a molybdenum base is desired for the target. On top of this, a homogeneous mixture of 2 to 10 microns tungsten powder and 2 percent by weight of 1 to 6 microns platinum powder is placed in the die. Thereupon a pressure of about 4 tons per square centimeter is employed to compact the powder in the die. The green compacts thus formed are then sintered under a high degree of vacuum or in an inert atmosphere such as hydrogen, helium or argon, at a temperature of at least 2,000° C. for two hours, and thereupon cooled under the protective atmosphere. The anode is then given its final shape by forging and grinding.

What is claimed is:

1. An X-ray tube target comprising a base and a focal track positioned thereon for electron impact, said focal track comprising an alloy of tungsten with from 0.05 to 5 percent by weight of platinum.
2. An X-ray tube target as in claim 1 wherein the platinum is present in the said alloy in an amount of from about 0.15 to 1.5 percent by weight.
3. An X-ray tube target as in claim 1 wherein the said alloy also contains an amount of rhenium of up to 10 percent by weight.
4. An X-ray tube target as in claim 3 wherein the platinum is present in the said alloy in an amount of from about 0.15 to 1.5 percent by weight.
5. An X-ray tube target as in claim 3 wherein the base comprises molybdenum.
6. An X-ray tube target as in claim 1 wherein the said alloy also contains a minor amount of at least one of osmium and iridium.
7. An X-ray tube target as in claim 1 wherein the base comprises molybdenum.
8. An X-ray tube target as in claim 1 wherein the base comprises graphite.

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9. An X-ray tube target as in claim 8 wherein there is an intermediate layer interposed between the graphite and the focal track, said intermediate layer being of a material capable of preventing reaction between tungsten and graphite.

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