

UNITED STATES PATENT OFFICE.

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PROCESS OF PREPARING METALS.

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Our invention relates to the process of making metal wires, threads and strips consisting of one crystal.

Heretofore, metal wires, threads and strips of a single crystal have been made and have recently excited much attention. Such single-crystal wires of tungsten are, on account of their manifold advantage, used as illuminating bodies for incandescent lamps. The object of our invention is a process of enlarging the cross sectional areas of single-crystal wires and of increasing their length. Applicants have found that if metal of the same kind as that of which the wire itself consists is deposited in a suitable manner on the wire, the deposit assumes the crystalline structure of the initial body and the diameter of the final body may be increased to a multiple of the diameter of the initial body and yet preserving single-crystal form. In the practice of the process care must be taken that the rate of deposit is not too great. By metal of the same kind, it is not to be understood that we mean exclusively chemically similar metal, but mean very generally a metal which has the same crystalline form as the core.

In describing the process of our invention it will be assumed, for example, that the enlargement of a single-crystal tungsten wire is to be effected. The wire of any desired length and having for example a diameter of 0.05 mm. is mounted in a receiver. The receiver is exhausted and then (the gas pressure being kept low at about 10 mm. of mercury) a mixture of hydrogen and tungsten hexachloride is sent through the receiver thus providing an atmosphere about the wire having as a constituent a metal of the same kind. A suitable mixture is obtained if, for example, hydrogen is saturated at 180° with tungsten hexachloride. The receiver should be kept at the same temperature in order to avoid the condensing of tungsten hexachloride. Now the single-crystal wire is brought to a glow (at about 1000° C.) by sending an electric current through it. The tungsten hexachloride is thus decomposed near the glowing wire and tungsten is deposited on the wire. By this process the diameter of the wire increases in five or ten minutes to three or four times and thus the cross sectional area increases from nine to sixteen times also. The final body will be found likewise of a single crys-

tal. This may, among other ways, be recognized by the fact that the original cylinder has assumed a prismatic form and sharp edges appearing, running the entire length of the wire, with plane surfaces between them. According to the chance position of the axis of the crystal in the initial body, the cross section of the final body will be quadrilateral, hexagonal or octagonal. If a ground cross section surface of the deposited body is prepared, and etched in accordance with the methods used in metallography, the deposited coating of metal shows the well known image of the single crystal structure. The boundary of the initial body is more or less effaced and often can hardly be found.

An increase of more than three or four times the original diameter is not desirable since then disturbances arise. Furthermore, it is not desirable to have the gas pressure, the concentration of the tungsten hexachloride or the temperature of the single crystal wire too high otherwise the separation of the metal is effected too quickly and the coating appears in the form of small crystals, stratified or even spongy and the final body is not angular.

The deposited tungsten obtained in the process described is brittle. It is found however that it becomes just as flexible and ductile as the single crystal if it is heated for a short time, which varies with the temperature used, at a high temperature somewhat below the fusing point. The deposited body made and treated in a manner described, may as is known of single crystal wire, be lengthened by mechanical working such as, drawing, rolling, hammering, pressing and stretching. The wire reduced, for example, to the initial diameter may then be covered again in the manner described by repeating the process. It is desirable however to take from it the tension arising in consequence of the mechanical working, before the new enlargement, by annealing at a high temperature.

What we claim as new and desire to secure by Letters Patent of the United States, is:—

1. The method of making metal wire consisting of a single crystal, which consists in depositing on a single crystal, metal of the same kind, from a gaseous atmosphere, the deposit being conducted at a limited rate

such as to avoid the formation of small crystals.

2. The method of making metal wire consisting of a single crystal, which consists in
5 depositing on a single crystal, metal of the same kind, from a gaseous atmosphere, the deposit being conducted at a limited rate such as to avoid the formation of small
10 crystals and thereafter heating at a sufficiently high temperature to render the metal ductile.

3. The method of making metal wire consisting of a single crystal, which consists
15 in depositing on a single crystal, metal of the same kind, from a gaseous atmosphere, the deposit being conducted at a limited rate such as to avoid the formation of small crystals and thereafter heating at a sufficiently
20 high temperature to render the metal ductile and thereafter drawing.

4. The method of making metal wire consisting of a single-crystal, which consists in
25 depositing on a single-crystal, metal of the same kind, from a gaseous atmosphere, the deposit being conducted at a limited rate such as to avoid the formation of small crystals and thereafter heating at a sufficiently
high temperature to render the metal ductile and thereafter repeating the process.

5. The method of making metal wire consisting of a single crystal, which consists
30 in depositing on a single crystal, metal of the same kind, from a gaseous atmosphere having hydrogen as a constituent, the deposit being conducted at a limited rate such
35 as to avoid the formation of small crystals and thereafter heating at a sufficiently high temperature to render the metal ductile and thereafter drawing.

6. The method of making metal wire consisting of a single crystal, which consists
40 in depositing on a single-crystal, metal from a gaseous atmosphere, the deposit being conducted at a limited rate such as to avoid the formation of small crystals.
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7. The method of making a metal unicrystal body grow as a unicrystal, which
50 consists in placing the unicrystal in an atmosphere having as a constituent a metal of the same kind and heating the body in such a manner as to cause metal of the same kind to be deposited on the body at a limited rate from the atmosphere.

In witness whereof, we have hereunto set our hands this 21st day of February, 1923.

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