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## PROCESS FOR MAKING MONOCRYSTAL ACTINIC SCREEN

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Our present invention relates to a process for making monocrystal actinic screens especially for any desired discharge tube as, for example, for cathode oscillographs, television tubes, electron microscopes, electron diffraction apparatus, electron spectrographs, and for the detection of gamma rays, by way of example, for images in radioscopy and similar purposes.

By monocrystal actinic screen is meant an actinic screen whose luminescent material is in the form of a two-dimensional grown monocrystal, in some cases also, of few very large two-dimensional grown crystals. Because of the purpose of the application in general only very thin layers of about one micron to ten microns are involved.

It has been known to build luminescent material out of a host lattice, for example, potassium bromide, and an activator, for example, thallium. In this former process there were obtained, however, crystal bodies which, because of their thickness, must first be split and finally ground to the thin plates required for the actinic shield. Moreover no pieces of relatively large area would be obtained by such process.

In our invention the very thinnest luminescent monocrystals can be formed from a monocrystal layer as a host lattice, with at least one activator, by coating a deposit of the selected host substance as a reception substance for the activator on a substrate crystal or substrate plate as an auxiliary plate in a vacuum and, at the earliest by this process transforming the deposit into a monocrystal. It is in accordance with this purpose that the auxiliary plate presents the same, or nearly the same, lattice metric, or lattice dimensions, as that of the material of the host lattice and is itself a monocrystal. The material for the auxiliary plate must not in any event belong to the same crystal class as the host crystal. Through this process an oriented deposit of the host crystal is attained on the surface of the auxiliary plate. Preferably the surface on which the monocrystal layer of the host is to be built up is held at an elevated temperature during the vaporizing or sublimation of the host substance so that the growth of the monocrystal layer of the host is promoted. In case the activator material will not be vaporized or sublimated with the material of the host lattice, the monocrystal layer of the host is finally tempered in the presence of the activator generating material (respectively of one or more metals) in a partial pressure empirically determined according to the host lattice and activator, with

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the goal of a diffusion of the activator atoms into the host lattice.

In the use of activator metals of very low vapor pressure one can so proceed according to the invention that after the building up of the monocrystal host layer one deposits the thinnest layer of the desired metal, for example, by cathodic atomizing and finally tempering. Obviously one can bring into the host lattice simultaneously, or in sequence, several different metals while one, for example, tempers the monocrystal layer first in a partial pressure of one and then in the partial pressure of the other metal.

In many cases it is an impediment to have the monocrystal as a deposit on a substrate plate. In a further development of the invention this can be remedied by choosing a material for this plate such as to provide, opposed to the monocrystal, a solubility in a given solvent differing as widely as possible from that of the monocrystal so that the substrate plate can be dissolved away.

In a further modification of the invention monocrystals can also be grown on isotropic bases as the substrate plate, such as glass and, indeed, by these means, so that the material will be vaporized or sublimed upon the isotrope substrate base, whereby it solidifies first polycrystalline and unoriented. Then the substrate base with the polycrystalline layer is brought into an apparatus in which a part of the layer is covered by a mask which lies near the polycrystalline layer. The mask possesses a slit initially narrow and widening toward the remaining surface of the layer. A wire, for example, of platinum, is stretched at right angles to the length of the slit and near the mask and is heated to a high temperature, in any case above the melting point of the polycrystalline layer. The wire is now moved in the direction of the slit with a speed which is less than, or equal to, the speed of crystallization of the material of the polycrystalline layer. The wire through its radiation accordingly melts down the part of the layer exposed by the mask and upon the further movement of the wire this molten part again solidifies. Since the slit is initially very small it insures that only one seed crystal is formed which then grows through the entire area. By manyfold widening, and narrowing of the slit before the widening on the complete breadth of the shield, one can with certainty attain the growth through the shield of only one seed crystal.

The introduction of the activators respectively through tempering in a partial pressure of the

activator can follow before or after formation of the monocrystal layer. Through suitable choice of the host lattice and of the activator, further, through suitable thermal treatment of the monocrystal layer a very uniform activation of the monocrystal layer can be attained. On the host lattice, activator and the manner of distribution of the latter in the host lattice depend the energy yield and the position of the maximum of light emission. The monocrystal actinic shield formed by the invention provides an especially great resolving power.

Obviously the surface on which the material is to be vaporized or sublimed must not be an optical flat.

*Example I*

A split plate of orthoclasse (potassium feldspar) as auxiliary plate is heated to 350° C. and is provided with a host layer by vaporizing potassium bromide thereon. After this has been tempered for several hours at the same temperature, the activation with, thallium, follows and a second or repeated tempering at the same temperature. Each step is done in a high vacuum.

*Example II*

A split plate of rock salt is heated in a high vacuum at 275° C. and dampened by the vapor of zinc sulfide. This host lattice is then activated with lead or copper at about 350° C. and tempered at the same temperature. The monocrystal layer thus obtained is cemented at its free surface to a glass plate by the use of a soluble cement and the auxiliary plate dissolved away from the salt with water.

*Example III*

An auxiliary plate of glass is moistened in a high vacuum by vapors of rock salt. This polycrystalline layer thus formed is covered by the above described mask and from the seeding point a platinum heating wire is conducted with a speed of about 5 mm. per hour. The monocrystal resulting therefrom is then activated with silver.

As auxiliary plate one may use according to the Examples I and II, material of suitable metric, or lattice dimensions or, on the other hand, also plates without monocrystal metric as in Example III.

As host substance the following are suitable: all alkali halides and alkaline earth halides ($CaF_2$, $SrF_2$); all sulfides (ZnS, CdS, MnS), and further, all host substances of phosphorus.

As activators may be used especially the metals; silver, copper, thallium, potassium, rubidium, magnesium, nickel, lead, strontium, barium, and rare earth metals.

In this specification and claims the term "lattice" is used to designate the sub-microscopic structure of the crystals as determined by an electron microscope. This lattice results from the



arrangement of the atoms in the solid structure. "Host lattice" is a lattice structure of the above type which serves as a support for a superimposed lattice of another substance. Orientation refers to the arrangement of the crystal lattices. A lattice is oriented when the lattices of the structure or crystal lattices are all arranged in the same direction and is not oriented when the crystal lattices are in an irregular or random arrangement. A host substance is a substance on which an active layer is deposited for support. An activator is a material which renders the actinic shield active, absorbing the rays and transforming them. A selected solvent is a solvent for one substance but not for another, being selected to dissolve one substance which is soluble in it and leave undissolved or undisturbed a substance not soluble in it. A seed point is a point from which crystallization starts and spreads. A two-dimensional metric is a characteristic lattice having measurements not in just one direction but in two dimensions.

Having described our invention, what we claim is:

1. Process for preparing monocrystal actinic screens from a monocrystal layer as a host for at least one activator which comprises applying a host substance on an auxiliary plate by precipitating said host on said auxiliary plate in polycrystalline form in vacuuo and in which said deposit is shielded within a border except for a narrow sector and is heated progressively from the point of this sector to said border in a narrow heating zone to transform said polycrystalline material into a monocrystal from a seed point and to widen the seeding throughout said layer within said border.

2. The process of claim 1 in which said narrow heating zone is moved from the point of the sector at a rate of movement not greater than the rate of crystallization of said host substance.

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