METHODS OF OBTAINING THIN LAYERS OF CADMIUM TELLURIDE AND THEIR ELECTRICAL AND PHOTOELECTRIC PROPERTIES

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AIIBIV compounds are a class of specific materials. On the one hand, their study is important for the development of the basic physical and chemical concepts of substances with a wide band gap, on the other hand, they have many interesting and important properties of practical use. Examples include electroluminescence, optical amplification and collection, photoelectric effect, particle transistor, and others.

Many electrical and optical phenomena have been disclosed and investigated in two-dimensional thin films or layers. Depending on the method of preparation, thin layers can be divided as follows;

1) monocrystalline curtains;

2) polycrystalline curtains consisting of small crystals with a significant preferential orientation (they are sometimes called block mono-crystalline curtains);

3) polycrystalline veils consisting of small irregularly oriented crystals;

4) amorphous layers; their crystalline structure is so weak that it is not possible to establish their crystalline order by conventional electron and X-ray diffraction methods.

The first application of AIIBVI layers was devices for dividing light streams, condensers, for which curtains were prepared by thermovacuum sputtering. But soon the vacuum evaporation method established the convenience of using only the optical and dielectric properties of the layers. This method did not work, for example, in obtaining fluorescent curtains. To exhibit luminescent and other semiconducting properties, the layers must be highly crystalline and must be doped with intrinsic defects or inclusions in a defined manner. In order to ensure this feature, the layers obtained by the thermovacuum method are subjected to heat treatment in order to eliminate deviations from stoichiometry and establish crystallinity.

The method of obtaining layers of AIIBVI compounds is similar to the method of growing bulk single crystals of the same compounds. Layer growth proceeds as follows. Steam or gases with elements in the order of combination are moved together near the substrate, where at a specified temperature they enter into a mutual reaction. (Chemical or gaseous transport method, which represents another type of gas-chemical method, is suitable for obtaining layers of AIIBVI and AIIIBV compounds). The main requirement for growth from the gas phase is the continuous transfer of vapors of the second and sixth group elements to the reaction and growth zone. The preparation of the microcrystalline membrane requires the formation of large amounts of buds on a heated growth surface. Growth from the budding centers continues until the microcrystals enlarge and form a contiguous layer, after which the veil grows only in thickness. The method requires continuous monitoring of the concentration of individual components in the gas phase, the distance from the source of steam to the base, pressure, temperature, etc. The shape and size of microcrystals and the degree of contact between them depend on the nature of the base surface, pressure, and temperature of the base. Despite this, the method is successfully used to obtain layers with a large face. Due to the fact that there are opportunities to experimentally establish the conditions of incubation and to hold them sufficiently constant, it is possible to ensure the repeatability of the technology. We will consider the principle of operation of the gas-chemical device, which is widely used in obtaining CdTe photovoltaic layers on large surfaces, in the example of obtaining CdTe:I, Ga layers used in solar cell elements. The dried mixture of Cd and CdI2 of the specified composition is transferred through the tube to the welded lower part of the quartz tube. At the same time, Te powder is introduced into the bottom of the chamber. Metallic gallium has a low vapor pressure, and its powder is difficult to obtain. Gallium is introduced into the chamber either as its chloride or as a liquid droplet. CdI2 reacts with Ga to form volatile gallium iodide GaI3. A thin molybdenum foil is often used as a base for obtaining elements for solar cells. In the technological process, CdTe adheres very well to the side wall of the chamber. To obtain a uniform coating on a large surface, a cylinder is made of molybdenum foil and placed coaxially on the walls of the chamber. A CdTe coating is applied to the inner surface of the cylinder. The vacuum impregnation method includes most of the vacuum impregnation methods "under the hood". Depending on the goals to be achieved, these methods differ to one degree or another from the classic "under the hood" pollination. A one-step process of applying layers to cold or heated substrates does not always ensure that the desired properties are achieved. The veils obtained in the one-step process are usually non-stoichiometric condensates or soon exhibit a mass of individual phases with them.

Such curtains are subjected to sweat treatment after condensation. Heat treatment of curtains is carried out not only to achieve stoichiometry, but also to transfer inputs to them in the majority of cases. In this case, the inputs may be unevenly distributed within the membrane or introduced from the gas phase. Inputs are inserted for electrical compensation or to increase photosensitivity. In many cases, heat treatment can transform the amorphous layer into a polycrystalline one. In high vacuum, heat treatment is practically not carried out directly in the chamber. In this case, processing soon leads to a stronger deviation from stoichiometry. The best results are shown by heat treatment in inert gases, such as argon. If alloying is required at the same time as heat treatment, the blanks are coated with pure or alloyed AIIBVI powder and processed in this condition. To increase photosensitivity, CdS and CdSe screens are also heat-treated in air. In order to get rid of some serious disadvantages of one-stage pollination, a "hot wall" is created under the hood. In this method, the substrate and vaporizer are inserted into a heated cylinder placed in the center of the hood. It is difficult for the evaporating gas to escape from the cylinder to the cylinder head and the traction system. In this way, a high dynamic pressure of the evaporating substance can be achieved. In addition, it is possible to free the evaporating molecules from collisions with the cold walls of the cap. Now they interact with the hot wall and it becomes easier for them to heat up to the temperature of the base. By means of this method, quite thick films of AIIBVI compounds with controlled stoichiometry and crystallinity were obtained. The basis of this method is close to the methods of gas transport and gas-chemical reactions.

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