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Influence of structure of resistive coatings of solid solution in Cu-N system on electrical properties

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Gas type detectors nowadays utilise a resistive coating known as DLC (Dimond Like Carbon). It is this coating that acts as a current limiting resistor that not only diverts the electron avalanche after multiplication, but also prevents electrical breakdown in the gas. The resistance of DLC coatings varies over a wide range from units of kOhm to hundreds of Gohm depending on the method of preparation [1]. It is experimentally proved that the stability of electrophysical characteristics of DLC thin films changes with time, which is a critical factor for detector operation for a long time (up to 5 years). For this reason, the actual task is to search for alternative coatings that meet the requirements of long-term operation in the detector without degradation of both the characteristics of the coating and the parameters of the detector itself. It is proposed to use compounds based on nitrides of simple metals (eg, copper (Cu), aluminium (Al)), as these metals are mainly used in the detector and will not contribute to the received signal from the reading electronics.
It has been previously found [2] that the electrical resistivity values characteristic of Cu3N coatings can be varied in the range of hundreds of mOhm to hundreds of Gohm by varying the nitrogen (N_2) concentration during sputtering. This flexibility in varying the most important functional characteristic of Cu_3N-based coatings is a definite advantage over DLC coatings.
1. With an increase the flow rate ⊠ from 3 to 10 l/h from 3 to 10 l/h, the centre of gravity of Cu-N (111) and Cu-N (200) reflections changes towards higher values, indicating the expansion of the crystal lattice.
2. Increasing the flow rate ⊠ from 3 to 10 l/h during film synthesis in the Cu-N system leads to a change in the stoichiometric composition of the coatings, manifested by a change in the contribution ratio of the reflex (111) from 45 to 80% and the reflex (200) from 57 to 83%.
3. I-V's Cu-N show a linear character from different ⊠ flow rates, but with different slope.
4. The samples show 'bubbles'of film delamination from the sample, and the thickness of the thin films varies from 10 to 17 nm.
5. The absolute resistivity R increases from 720 Ohm to 1.34 MOhm with increasing flow rate ⊠, and the resistivity increases from $7.2 \cdot 10^{-6}$ to $1.3 \cdot 10^{-2}$ Ohm ·m.
6. The change in resistivity is directly proportional to the position of the centre of gravity of the Cu-N reflex (111) and (200).
7. The results indicate the possibility of using films based on solid solution in Cu-N system as resistive coatings in gas discharge detectors.
8. Variancing the electrical resistivity of Cu-N thin films will make it possible to study the operation of the resistive electrode in detectors and the mechanism of electron avalanche injection.

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