PROPOGATION OF A PULSED ELECTRON BEAM IN GAS COMPOSITIONS OF CARBON-CONTAINING COMPOSITE NANOMATERIAL SYNTHESIS REAGENTS*

G.E. KHOLODNAYA, D.V. PONOMAREV, R.V. SAZONOV, M.A. SEREBRENNIKOV, O.P. LAPTEVA

Tomsk Polytechnic University, Tomsk, Russia

Carbon-containing composite nanomaterials are of great interest to researchers in chemistry, medicine, biology, and materials science. The physicochemical properties of nanomaterials depend on the synthesis method, on the composition of the mixture of initial reagents, on the synthesis temperature, and on the duration of the process [1]. To date, carbon-containing nanomaterials can be obtained by the sol-gel method [2]. The process is carried out at high temperatures, and the use of catalysts is also required, which shall be removed from the final product at the end of the process.

It seems promising to use the pulsed plasma-chemical method to synthesize nanomaterials. Efficient input of energy into the gas by a pulsed electron beam due to elementary processes of the first kind (collision ionization, dissociative electron attachment, etc.) significantly reduces the energy costs of the synthesis process. Investigation of the processes occurring during the interaction of pulsed electron beams with objects with a complex chemical composition, which are the key ones in technological processes, is topical.

The paper presents the results of comprehensive studies of the efficiency of the propagation of a pulsed electron beam in a mixture of gases: titanium tetrachloride (6 mmol) and hydrogen (18 mmol); titanium tetrachloride (6 mmol) and methane (18 mmol); titanium tetrachloride (6 mmol) and oxygen (36 mmol). The signified components are the initial reagents or products of plasma-chemical reactions of the synthesis process using pulsed electron beams.

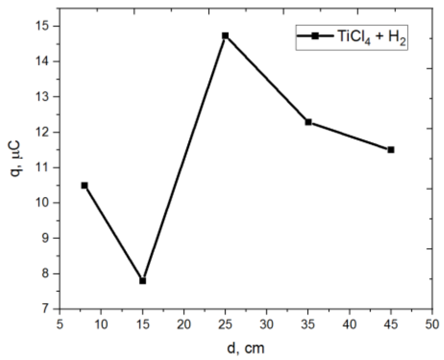

Fig.1. Dependence of an electron beam charge, having reached the collector of the Faraday cup, on the distance.

The investigations were carried out using a test bench including a TEA-500 pulsed electron accelerator, a drift chamber, and a sectioned cut-off calorimeter with a beam charge control function. The main characteristics of the electron beam are as follows: 60 ns half-amplitude pulse duration, up to 200 J pulse energy, and 5 cm beam diameter. During the experiments, the drift chamber was filled with the investigated gas, into which the electron beam was injected. Using a reverse current shunt, the charge of the electron beam was determined. The energy distribution over the beam cross section was measured using a sectioned calorimeter. The sectioned calorimeter with the beam charge control function was installed inside the mobile tube, which made it possible to perform measurements at a variable distance from the accelerator output window along the entire length of the drift chamber.

REFERENCES

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