SYNTHESIS OF C-N POWDER MATERIALS BY ARC DISCHARGE PLASMA*

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Carbon nitride C_3N_4 is binary compound of carbon and nitrogen. There are seven different phases of C_3N_4: α - C_3N_4, β - C_3N_4, cubic C_3N_4, pseudocubic C_3N_4, g-h-triazine, g-h-heptazine and g-o-triazine. Among them, β - C_3N_4 crystalline phase has similar hardness/low compressibility to that of diamond. However, today more and more attention is paid to the hexagonal or so-called graphite-like carbon nitride h-C_3N_4 (g-C_3N_4) [1]. This material are currently being studied for a wide range of applications, such as main catalyst in hydrogen photocatalysis [2], as a coating for implants in biomedicine [3], as a precursor for synthesis of superhard phases of C-N system [4].

One of the methods to obtain the g-C_3N_4 is electric arc discharge method [5,6]. Today this method is developing in the direction of vacuumless synthesis. In this regard, an attempt to synthesize crystalline C-N powder materials by atmospheric arc discharge plasma has been done.

Figure 1 shows typical current and voltage waveforms taken by oscilloscope during the experiment.

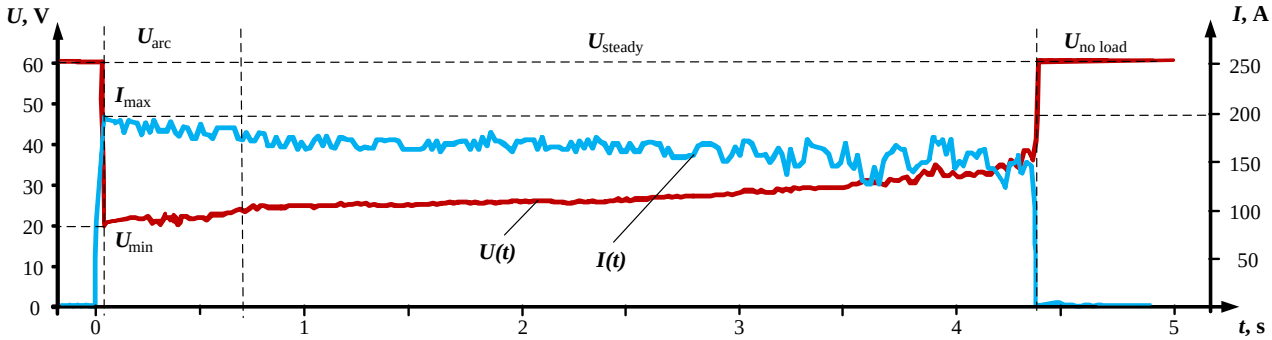

Fig. 1. Typical current and voltage waveforms taken during the experiment

As it can be seen from the fig.1, at the initial time voltage on the electrodes is equal to the no-load voltage of the power supply U ≈ 60 V, the discharge circuit current is zero. Then, at the moment of discharge initiation, the voltage drops to the minimum value of U ≈ 20 V, respectively, the current increases to the maximum value of I ≈ 200 A. After the discharge gap is formed, the voltage and current of the system stabilize to steady-state values U ≈ 30 V and I ≈ 160 A, respectively. After the end of the arc discharge, at the time t = 4.4 s, the current value drops to zero, the voltage is restored to its initial value, equal to U ≈ 60 V. It should be noticed that in the time interval from 0.1 s. to 4.4 s. the voltage increases by ΔU ≈ 8 V. This is explained by anode evaporation, therefore, anode length decreases, and the discharge gap size increases.

Based on the data from Fig. 1, the dependences of power and energy on time were obtained. Power is maintained in the range of 0.2-4.4 s. Moreover, the P(t) waveform is similar to the I(t). The average power is equal to 4 kW during the experiment. In turn, the power provides energy release in the system, equal to 21 kJ for 4.4 s.

Thus, in this paper, the changing of experiment parameters, such as arc current, voltage, power and energy, obtained during the synthesis of C-N powder materials, was analyzed.

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