

Synthesis of fullerenes and other nanomaterials in arc discharge

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Fullerenes are the only soluble form of carbon. Some scientists applied them for technological tasks, others for the synthesis of new materials. Fullerenes would arouse more interest, if they were cheaper and more available. Thus, obtaining an effective technique of fullerene synthesis remains an actual task.

At present the arc method of carbon transformation from graphite to fullerenes is considered to be more effective. Arc in helium flow at atmospheric pressure does not require vacuum and this may simplify the task. In this talk the results of fullerene synthesis in the flow of carbon-helium plasma at atmospheric pressure will be presented. The arc was maintained at ac (44 kHz, 50 Hz), dc and combination of ac and dc.

Our investigations have shown that the synthesis at high frequency current (HFC) is more effective. Conversion from graphite to fullerene soot is equal to 80% at 10% fullerene content. Relative abundance of the fullerenes is kept at the same level (within measuring error) at all types of current, high fullerenes content is 3-4%. Owing to higher rate of electrode erosion the combined arc feeding by HFC and DC increases the rate of fullerene production, although the fullerene content in soot decreases. Thus at 190 A HFC and 280 A DC, the rate of fullerene synthesis is 6.5 g/h, conversion from graphite to fullerene soot is 98%, fullerene content is 3.5%.

Interesting results are observed at the effect of different physical fields on fullerene arc. The influence of acoustic waves leads to increasing rate of fullerene soot production by two times without additional energy or gas consumptions. Such soot contains 8.5 % of fullerenes.

The influence of electro-magnetic fields depends on geometry and size of chamber, phase shift between arc current and field current. Under this influence fullerene yield can increase as well as decrease. Physical fields influence the synthesis of fullerene derivatives positively.

These experimental data are in good correlation with our theoretical calculations of fullerene formation process, which have been implemented taking into account electron concentration, temperature and effect of buffer gas cooling.