

Technology and main products of single-walled carbon nanotubes produced by arc discharge process

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ICP RAS has developed technology and equipment to produce single-walled carbon nanotubes (SWCNTs) based on the arc discharge process as a result of accomplished R&D contract entitled “Technology and equipment for production of high quality single-walled and multi-walled carbon nanotubes”. A technological setup has been designed to produce up to 50 g/shift of raw-SWCNTs (as-produced condensed arc discharge products) with nanotube content of 15-25wt.%, and up to 5-10 g/shift SWCNT-products of different degree of purification including SWCNT-powder with 90 wt.% of nanotubes and SWCNT-colloidal solution with 98 wt.% of nanotubes in dispersed phase.

The main characteristics of production technology are the following:

- a specially designed arc reactor (supported by RF patent) allows one to work in semiautomatic conditions. Design solution of the reactor allows the yield of condensation products to be increased to ~ 30% of evaporated carbon and percentage of nanotubes in raw SWCNT material up to 20-25 wt.%;
- a combination of chemical and physical methods of purification is used to attain both high percentage of nanotube recovery from raw SWCNT material and high quality of the final product;
- special methods of material treatment are involved to retain high dispersion of nanotube in the desired product.

Comparison of developed technology with existing one reveals the following advantages of the former:

- 1) 10 times higher capacity for one technological setup in production of high-quality desired product;
- 2) developed technology allows the treatment of “lean” raw SWCNT material, which make it possible to scale up arc discharge production technology provided that such scale-up is inevitably associated with raw SWCNTs quality lowering.

Advantages of technology of SWCNT synthesis and purification are pronounced in coSt of final products. Calculated net costs of proposed products should be 2-3 times lower than those existing in the market.

The list of products which are either produced or at the final stage of preparation is presented and discussed. Some properties, which are important in commercial application of SWCNTs, are listed along with measurement techniques for SWCNT product certification. A market niche for arc discharge synthesized SWCNTs is discussed.