PLASMA PRODUCTION OF ULTRAFINE MATERIALS [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.113

Dudnik Yu.D., Kuznetsov V.E., Safronov A.A., Shiryaev V.N., Vasilieva O.B.

Institute for Electrophysics and Electric Power, Russian Academy of Sciences, St. Petersburg, Russia, iperas@nw.ru, julia\_dudnik-s@mail.ru

One of the most promising technologies for the ultrafine materials production is plasma process. The high temperature (enthalpy) of the plasma flow and the rate of its change allow efficient energy input into the treated material and lead to the homogeneous nucleation in the vapor-gas mixture.

Arc-jet gas heaters (plasma torches) of alternating current, direct current or microwave plasma torches can be used for this process.

A number of papers [1-3] consider processes of nanomaterials production using direct current plasma arc and high-frequency plasma arc. It can be concluded that direct current plasma torches with power up to 100 kW or high frequency plasma torches with power up to 50 kW are used for plasma thermal production of ultrafine materials. On the other hand, the use of the alternating current plasma torch for a plasma chemical reactor allows minimizing the size of the plant, simplifying the design of the power supply system and applying the standard industrial electrical network. They have a higher economic efficiency, which can be explained by the presence of the long lifetime.

The paper considers the experimental plant for plasma thermal production of ultrafine materials based on a single-phase alternating current plasma torch with a power up to 50 kW. This type of the plasma torch is capable of working with various plasma-forming media at plasma-forming gas consumption of up to 30 g/s, the electrode life time about 200 hours [4, 5]. This makes it possible to produce ultrafine materials in a continuous cycle, while ensuring high chemical purity of the process.

The results of experimental studies of ultrafine oxide materials production (iron (III) oxide, aluminum oxide, etc.) are presented.

References

1. Production of ultrafine metal powders by arc plasma / Uda M. // Nisshin Steel Tech. 1989. Rep. 61. Р. 90-99.
2. Production of ultra-fine silicon powder by the arc plasma method / Tanaka K., Ishizaki K., Yumoto S., Egashira T., Uda M. //Journal of Materials Science. 1987. V. 22, P. 2192–2198.
3. Formation of ultrafine Niparticles in reduced or atmospheric pressure Ar and H2 plasma jets / Kikukawa N., Kobayashi M., Sugasawa M., Sakamoto H. // J. High Temp. Soc. Jpn. 1992. V. 18 P. 235-247.
4. AC plasma torches. arc initiation systems. design features and applications / Safronov A.A., Kuzhnetsov V.E., Vasilieva O.B., Dudnik Yu.D., Shiryaev V.N. // Instruments and Experimental Techniques. 2019. V. 62. № 2. P. 193-200.
5. Operation of high-voltage plasma torches with rod electrodes / Safronov A.A., Vasilieva O.B., Dudnik Yu.D., Kuznetsov V.E., Shiryaev V.N. // High Temp. 2018. V. 56. № 6. P. 849-852.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Lt/ru/EP-Dudnik.docx) [↑](#footnote-ref-1)