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COMPARISON OF THE PRODUCTION OF SPHERICAL PARTICLES IN THE ELECTRIC EXPLOSION OF A WIRE AND A LOW-POWER DISCHARGE USING A LIQUID ANODE

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The work is devoted to the study of spherical particles produced by the methods of (i) electric explosion of wires (EEW) and (ii) a low-power discharge using a liquid anode (LA). The spherical particles themselves may be of practical interest for additive technologies and other applications. Currently, there are various methods for producing spherical particles [1], one of them is close to the liquid anode method, like the liquid cathode method, but has a higher discharge energy (electrical parameters of the described liquid cathode method [2]: 300-1000V, 100-300A).

The commonality of the processes of the presented methods is the expansion of metal droplets and their rapid cooling in the environment (Fig. 1). In the two methods under consideration, the main difference is the difference in the discharge currents, so for the EEW method the discharge current was tens of kiloamperes at a discharge voltage of kilovolts (current density up to 108 A/m), and for LA method 150-300V, currents up to 0.6A (current density up to 103 A/m). There was also a difference in the scheme of the experiment, with EEW, the conductor was placed between two brass rods, which were the electrodes of a high-voltage battery, and a pulsed current was passed through it, with an LA, the wire was periodically lowered into the liquid anode until the formation of metal expansion from the electrode.

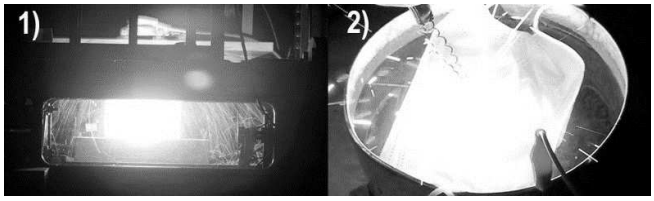

Fig.1. The process of scattering of metal droplets (sparks) during EEW(1) and LA(2).

In these processes, particles of an ideal spherical shape were mainly obtained (Fig. 2). But with EEW, more particles of non-ideal shape (with chips and deviations from sphericity) were obtained than with LA. On fig. 2 shows the results of experiments with a galvanized iron conductor, 0.8 mm in diameter, the electrolyte for LA was a solution of water with sodium chloride. The chemical composition of the particles in both cases was iron oxide.

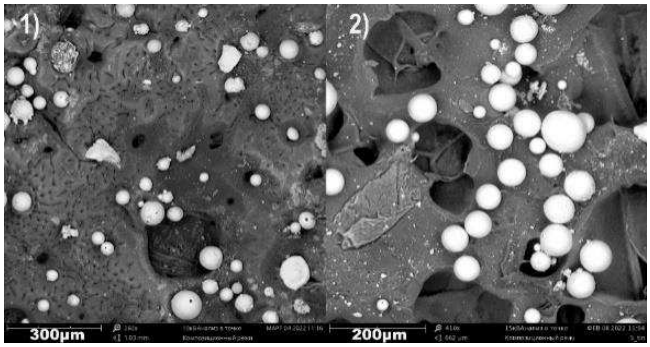

Fig.2. Spherical particles of iron oxide photographed through a Phenom ProX electron microscope obtained with EEW(1) and LA(2).

The diameter of the resulting spherical particles with EEW and LA is 15-150 μm, this range is of interest for use in additive technologies. From the point of view of practical implementation, the LA method seems to be simpler, not only in comparison with the EEW, but also with other currently existing methods for obtaining spherical particles. As part of experiments with the LA method, it has been shown that it can be used to obtain spherical particles from various materials, such as stainless steel, titanium, while for tungsten and copper, the results are currently unsatisfactory due to the presence of a large number of non-spherical particles.

REFERENCES

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