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SPARK DISCHARGE IN A LIQUID WITH ALUMINUM GRANULES IN THE INTERELECTRODE SPACE AS A SOURCE OF ALUMINUM HYDROXIDE NANOPARTICLES *)

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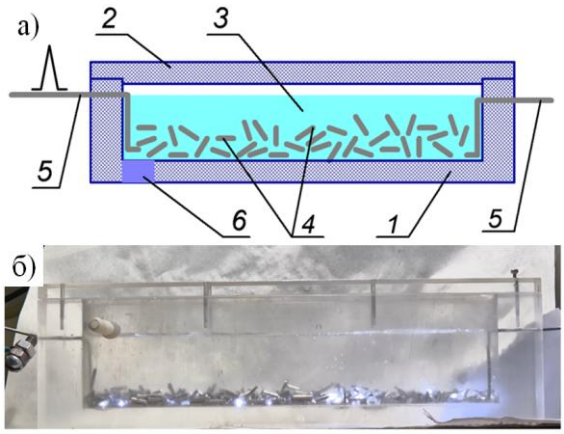
Traditionally, chemical methods are used to synthesize metal nanoparticles, which have a number of significant drawbacks: chemical technological solutions are often expensive, hazardous to human health and environmentally dirty. One of the possible alternatives is to use a spark discharge to synthesize nanoparticles [1]. This method is environmentally friendly, easily scalable and at the same time quite productive.

In this work, a spark discharge in aqueous solutions (deionized water) with aluminum inclusions in the interelectrode space was studied. The discharge system was powered by an original high-voltage five-channel high-voltage pulse generator. Parameters of one channel: energy of the storage capacitor E ~ 1.6 J, pulse repetition rate f ≤ 100 Hz, U < 20 kV, I ≤ 250 A. The conductivity of the liquid varied from 1 to 1000 μS/cm. When a high-voltage pulse was applied, the current channel was formed along a random path due to the breakdown of multiple gaps on short clearances and loose contacts of metal inclusions. The production of $Al(OH)_3$ nanoparticles occurred due to the spraying of the electrode material. The resulting fraction of nanoparticles is aluminum hydroxide in two crystalline phases Bayerite and Gibbsite. The yield of nanoparticles was ~ 0.2 g/min. The characteristic particle size was from 5 to 100 nm. It was found that the conductivity of water affected the morphology and phase composition of nanoparticles. In this case, in the case of using water with a conductivity of 1 μS/cm, a statistically stable mode of initiation and closure of the discharge was observed, in contrast to highly conductive water (1 mS/cm).



a) – diagram of the discharge chamber, b) – photo of the discharge chamber. 1 – discharge chamber, 2 – chamber cover, 3 – aqueous solution, 4 – metal inclusions, 5 – high-voltage electrodes, 6 – quartz window.

The obtained experimental results will be in demand in further studies when obtaining nanoparticles and their agglomerates with controlled parameters.

References

[1]. Saito G., Akiyama T. Nanomaterial Synthesis Using Plasma Generation in Liquid. Journal of Nanomaterials. 2015. 1-21. DOI:10.1155/2015/123696

*) abstracts of this report in Russian