Nanoparticles generation modes of the multi-spark discharge generator

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Production of nanoparticles is an urgent task, due to the high needs of industry in the materials with unique physical-chemical properties for creation of new devices and products on their basis. The unique physical and chemical properties of nanoparticles are caused by surface and quantum size effects.

Although there are many methods to produce nanoparticles, we have chosen the method of spark discharge as a highly scalable and versatile method for the production the nanoparticles of metal and semiconductor materials, Tabrizi *et al* (2009). In this work, we have built and tested the spark discharge generator (SDG) with three spark gaps connected in series, Figure 1.

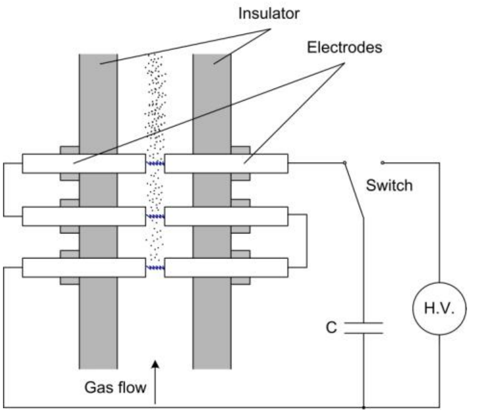

Figure 1. Schematic of the spark discharge generator.

Series connection of many spark gaps in the SDG in comparison with one-spark case allows generating larger quantities of aerosol nanoparticles with stable particles size distribution. The high voltage power supply HV was used to charge the capacitors in a voltage range from 0 to 5 kV. In the experiments we used capacitors varied in the range since 0.1 uF to 0.5 uF. Electrodes, between which the spark occurred, were made in the form of cylinders of about 100 mm in length and of 5 mm in diameter. The titanium and aluminum electrodes were used in the experiments. Air flow was regulated in the range from 0 to 160 l/min. Maximum frequency of the discharge pulses was 10 Hz.

According to literature most of the works regarding measurements of particle size distribution of aerosol particles generated by SDG was performed with a scanning mobility particle sizer (SMPS). However the SMPS can limit the accuracy of measurements particle size distributions because the particles generated by the SDG may be nonspherical. Moreover due to the small particle size there will be an error in charging efficiency. In order to avoid these factors, we used a different method of measuring the aerosol nanoparticles. The particle size distribution was measured using diffusion aerosol spectrometer DAS (model 2702, «AeroNanoTech» LLC, Russia). Its method of measurement is based on analysis the coefficients of particles penetration through a section of the diffusion battery, Julanov *et al* (2002).

During the experiment the influence of the SDG operating parameters on the particle size distribution was determined. Operating parameters of the SDG were: charging voltage (U), spark frequency (f), capacity (C), gas flow rate (Q) and electrode material (Me). A typical example of the measured distributions are shown on Figure 2.

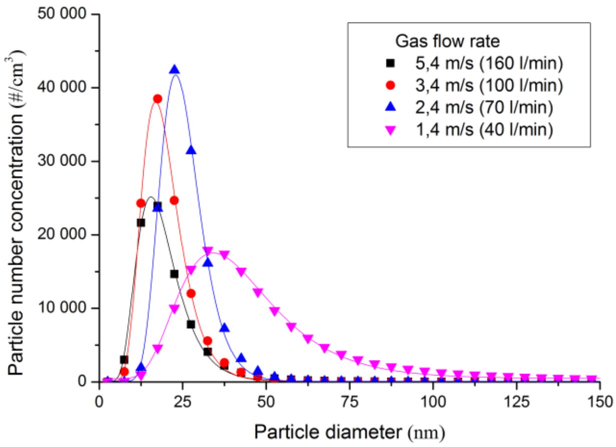

Figure 2. Effect of gas flow rate on the particle size distribution measured with DAS 2702 (titanium electrodes; C = 0.33 uF; U = 2.0 kV and f = 0.5 Hz).

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