

The formation of solid charged aerosol particles at the destruction of metal bodies and bodies of other materials

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Now in CIAM the important electric effect is under investigation. The effect consists in formation of an electric charge on solid particles, formed at the destruction of bodies (the elements of technical devices) of various materials (metals, dielectric and composites).

Registration of such charged particles, which are carried out from the device with gasdynamic flow, provides the possibilities of electrostatic diagnostics of the beginning and development of process of a body destruction. The efficiency of such diagnostics directly depends on the knowledge of a sign of the charge of particles arising at destruction. It demands carrying out of special experimental and theoretical researches.

A number of experimental researches on electrostatic diagnostics on laboratory installations and on aviation engines was carried out. The laboratory installation included the equipment for tearing of bodies on which the destruction of cores or plates was carried out. The tearing place was blown by an air stream. In tearing the particles (solid aerosol fragments) arose which were taken down by the stream. The specially located antenna registered an electric signal from these particles. Their size of the particles was estimated on registration of integrated characteristics of light scattered by the formed particles under small angles and was considered to be about 50-100 microns.

In the researches the fundamental result earlier received by us was confirmed. The particles formed at the destruction of metal bodies are positively charged. Their total charge was appeared to proportional to the tensile strength of the material and to a square of the characteristic size of a body (e.g. the plate thickness, Vatazhin et al, 2003, Golentsov et al, 2012). The new results by definition of the sign of the charge of the particles formed in tearing of "non-standard" metal samples were obtained (the plates with holes, the bodies with the cavities filled with other particles). The interesting effect was found out: the particles arising at destruction of the body and the particles before being in the cavity in it are charged opposite.

The research of the formation of the charged ice particles was carried out in being covered with ice of elements of aviation engines. At work of the modelling turbine on not operational mode there was a temperature drop of the gas stream. It led to covering with ice of the turbine elements. At turbine operation, the ice particles broke from the turbine elements and were taken out from the turbine by the air stream. On an exit of the turbine the special antenna was fixed that registered the flight of the charged ice particles by it. On fig. 1 the registered signal is shown. Each peak represents the flight of the charged ice group. The analysis of signals was shown

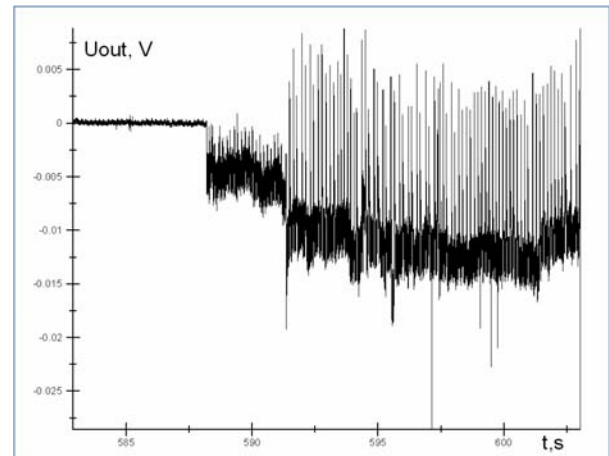


Figure 1. The electrostatic antenna signal in frosting-up of the modelling turbine elements

that, unlike the particles arising at destruction of metal bodies, the charge of ice particles is negative. So it allows to assume that dielectric particles are charged negatively, unlike the metal ones. It proves to be true also in modelling experiments on tearing of dielectric samples of plastic.

The conclusion. On the basis of the researches of the formation of the solid aerosol particles in destructing of bodies of various materials, the method of electrostatic diagnostics of abnormal conditions of engine and power devices with air flow channel is improved. The examples of successful detection of abnormal operation state of aviation engines were shown.

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Vatazhin A.B. *et al.* (2003) *Fluid Dynamics*. **38**, 1, 69-77.

Golentsov D.A. *et al.* (2012) *Measurements world*. **5**, 52-58.