THE AVERAGE OPTICAL-SIGNAL POWER AS A CHARACTERIZER OF THE EXPLOSIVE TRANSFORMATION OF POROUS SILICON-BASED COMPOSITE WITH BARIUM PERCHLORATE

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Abstract: The current investigation aims at the explosive transformation (ET) of porous silicon-based composites with barium perchlorate. Five sets of samples, differing by the porosity of the silicon used, have been prepared and the optical signal accompanying their explosive reactions has been collected. The silicon porosity varied from 29%–35% to 61%–69%. Results demonstrate that the increase of the porosity of silicon compacting under fixed pressure into a container causes higher fuel porosity, lower fuel density, and greater values of the average optical-signal power. The increase in the ET rate is considered to be responsible for the latter result.

Keywords: energetic composite; porous silicon; barium perchlorate; explosive transformation; explosive reaction; average optical signal power

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Figure Captions

Figure 1 Setup schematics: *1* — laser light source; *2* — digital oscilloscope; and *3* — sample mounted on a massive holder. The photodetectors 1–4 attached to flexible holders are numbered and distinguished by assigned color. The origin of the spherical coordinate system shown in Fig. 1 coincides with the center of the open end of the container with the energetic composite. The open end of the container lies in the xz plane while the initiating laser radiation propagates in the yz plane

Figure 2 Average optical-signal power W vs. the fuel-to-oxidizer ($F : O$) mass ratio . The squares and triangles represent the samples examined under geometries 1 and 2 of the photodetectors' arrangement. Black, gray, and white marker colors correspond to the samples from the "fast," "medium-rate," and "slow" categories, respectively. The sample name consists of the series name and individual number. The additional number given along with the sample name is its mass in mg

Figure 3 The time-dependent intensity of light accompanying the ET for F4 (*a*), K3 (*b*), and L7 (*c*) samples from the "fast," "medium-rate," and "slow" categories. The oscillogram visualization procedure did not include the step of background subtraction. The individual numbers of registration channels match the numbers 1–4 of photodetectors. The colors indicating the distinct registration channels in Fig. 3 and the photodetectors in Fig. 1 are the same

Table Captions

Table 1 The conditions of the two-sided electrochemical etching of the single-crystal silicon wafers and the porosity of the resulting silicon product as well as the number of samples in a series yielding from each wafer

Table 2 The relation of the porosity P_{fuel} and density ρ_{fuel} of the silicon component of energetic composite to the porosity P of the single-crystal silicon wafer electrochemical etching product

Table 3 The spatial arrangement of photodetectors relative to the sample for two fixed geometries and the correspondence of the geometries to the results of sample series studies

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