Development of modified recoil force gage for studying gasification processes of energetic materials

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Starting from 1970-th the recoil force gages were introduced into laboratory practice for measuring instantaneous burning rate response to the action of external transient radiant flux [1,2]. American and Italian researchers usually used for these measurements sensitive quartz pressure transducers (like Kistler, etc.) with fast time response and great force sensitivity. However, the total set up which included sample support and force transmittance units essentially reduced delivered force sensitivity time response of device. Besides, the devices possessed rather high sensitivity to variations of ambient temperature and pressure.

Another option of the recoil force set up has been elaborated and employed for years in the Institute of Chemical Kinetics and Combustion (USSR). It was based on the original design capacitance gage and flexible mechanical system to mount a propellant sample. The force sensitivity of gage comprised $3 \cdot 10^{-5}$ N and working frequency band was 400 Hz that allowed measuring the variation of recoil force in transient combustion of typical propellants samples of 10 mm in diameter. This device was widely used for investigations at atmospheric (constant) pressure but practically could not be used at time dependent pressures. In order to provide better possibilities of using the device at transient and elevated pressures and to enhance the force sensitivity it has been essentially modified recently. For this end the mechanical unit design of the gage has been changed and the principle of capacitance measurement improved. The effect of variation of dielectric properties of environmental medium was eliminated due to application of additional capacity into the electrical scheme. In addition, the recording capacity along with additional capacity were included into the bridge circuit that provided increasing the gage force sensitivity at least up to $6 \cdot 10^{-7}$ N with working frequency band being increased up to 2000 Hz. In the presentation, the technical description of the device is given as well as some examples of its use for measurement of recoil force signal in transient combustion conditions. The future development of device involves further improvement of the working parameters and making automatic measurement system on its basis.

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2. Mikheev V. F., Zarko V. E., Borin S. M., et al. Measurements of burning rates in transient combustion processes under the influence of external radiation. In: Progress in Astronautics

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