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Short Communication

A MODIFIED CONTACT THERMAL HEATER FOR SHORT-TIME POLYMER DESTRUCTION STUDIES

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Abstract

A new design of rotation heater has been suggested for the short-time polymer thermal stability registration.

Keywords: contact thermal analysis, rotating heater

The previously described devices of quick-response contact heaters for the study of short-time thermal destruction of polymers [1–3] have many drawbacks. The most annoying are the following:

– A rather sharp impact against the polished metallic plate (as sample substrate) during loading of the sample,

– Inconstant clamping force on the sample during the experiment

– Possibility of sample vibrations during test due to too low power force of the sample holder.

For elimination of the above mentioned drawbacks a modification of the sample heater is suggested. In contrast to the previous recommended rotating heater [4] the new device is designed for a fixed electrical wire-heater, surrounded by a rotating polished hollow metallic cylinder shell, open from the one side (Fig. 1). The new device assures the separation of the shell from the electrical collector rings for power supply of the heater.

For measurement of the surface temperature of the rotating metallic shell designed as substrate for the polymeric sample contact thermocouples are used, which are clamped on the one end against the metallic surface of the rotating shell.

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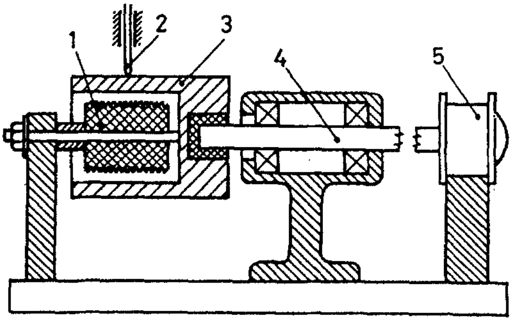

Fig. 1 Scheme of the modified device of the contact heater. 1. fixed electrical wire-heater, 2. sample, 3. rotating hollow metallic shell, 4. spindle, 5. gear transmission

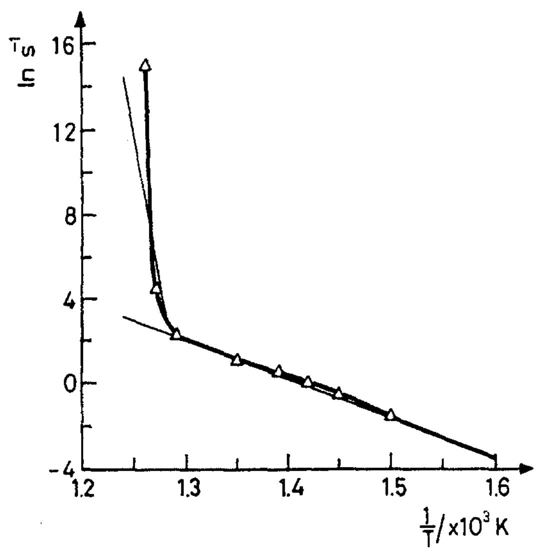

Fig. 2 Arrhenius plot of the thermal destruction of PMMA. Triangles – experimental data, Lines – fit of experimental data

Results of first measurements are exemplified in Fig. 2, as shown the Arrhenius plot of the log average reaction rate constant, k, of the thermal decomposition of poly(methylmethacrylate) *vs.* the reciprocal absolute temperature. The experimental data are fitted (full line) using the approximate equation:

$$y = \ln(2.2\ e^{11}\exp[(-18.500)x] + 2.0\ e^{11}\exp[-29\ e^{4}(1-0.0012/x)x)]$$

where $x=1/T$. The first term reflects the chemical reaction rate constant with 18.500 the corresponding activation energy. The second term is related to the frequency of nucleation, characterized by an activation energy of 290.000

cal mol^{-1}, which decrease during reaction because of decreasing surface tension with increasing temperature. 2.2 e^{11} and 2.0 e^{11} are the respective preexponential factors.

The equation resulted by fit of the experimental data is in accordance with the theory of heterogeneous reactions with one stage nucleation process [5].

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