The Influence of the Green Mixture Density on the Sample Elongation in the Heating Zone of the Combustion Wave

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As shown by experimental investigations, combustion of samples pressed of metal-nonmetal mixtures is often accompanied by a considerable increase in the sample length. As a rule, the process of elongation is caused by the release of gases dissolved in the metal powder, degasation of impurities contained in the initial reagents, and the moisture desorption. At present it is believed that the sample is elongated in the combustion wave heating zone, wherein the major amount of impurity gases is released. However, a direct experimental evidence for validity of this hypothesis is not available.

In the present study an original method developed by the authors was used to determine the dependence of the relative elongation of the sample ε_1 in the heating zone on the green density of the mixture and its contribution to the total relative elongation of the sample ε.

The position of the combustion front and the upper edge of the sample at each moment of time was recorded with a video camera and then a 10-times magnified image was displayed on the TV screen. The screen-to-screen processing of the images allowed us to determine the combustion velocity and the rate of the sample elongation. The relative elongation of the sample was calculated with the use of the values of the initial sample length and the sample elongation during combustion. The value of the relative elongation of the sample in the heating zone was derived from the proposed by Vadchenko formula at the assumption that at stationary combustion of the green mixture the sample elongation was also a stationary process (regarding the front-involving system of coordinates).

The samples were pressed of a stoichiometric powder mixture of PTS titanium and PM-15 carbon black. The initial Ti powder was separated to two fractions of 20-25 and 80-125 μm. A qualitative character of the dependence of the sample elongation on its density in the heating zone was found to be the same for both fine- and coarse-grained mixtures. Noticeable elongation in the heating zone was observed only for the initially low-dense samples. However, even in this case, the ratio of the ε_1 value to the total relative elongation ε did not exceed 10%. The increase in the initial density of the green mixture caused a fast decrease in the ε_1 value and at the relative density of the sample higher than 0.55 all changes in the sample length occurred behind the combustion front. Diminishing of the ε_1 value at the growth of the green density was probably determined by the increase in the sample strength. Thus, the it can be stated that during the Ti-C system combustion the main elongation of the sample takes place behind the combustion front.

On the basis of the investigations performed, it can be claimed that in the Ti-C system the sample is mainly elongated and, consequently, the impurity gases are released behind the combustion front and not in the heating zone as accepted in the current scientific literature.

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