ON THE DETERMINACY OF RESULTS OBTAINED IN A STUDY OF THE THERMAL CONDUCTIVITY AND DIFFUSIVITY OF CERAMIC MATERIALS

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UDC 536.2.083

In a study of the thermal conductivity and diffusivity of ceramic materials, for the purpose of a more complete characterization of specimens (to include the number and the development of microcracks), it is proposed that the parameters of mechanical strength be added.

It is well known that published test values on the thermal conductivity and diffusivity of ceramic materials are spread over a wide range. In the case of magnesite refractories, for example, this spread (with the same chemical composition and the same porosity) is 70-100% and in the case of Dinasite refractories it is 50-70% [1], which obviously exceeds the measurement error. The most probable cause of these discrepancies seems to be the variance between macro- or microstructure specimens examined by the various authors [2]. Unfortunately, the specimen characteristics given in handbooks and in original research papers are often incomplete, making it difficult to analyze and to compare the results of different studies. The problem concerning the determinacy and the compatibility of results obtained in thermal conductivity and thermal diffusivity studies on ceramic material is very relevant to research on the thermophysical properties of matter.

The basic parameters usually characterizing a specimen are its chemical composition and its porosity (or density), which, apparently, do not suffice. For instance, it is well known [2-3] that both the thermal conductivity and diffusivity of porous materials depend largely on the number and the size of microcracks in work pieces, i.e., on pores with a small volume but a large developed surface. As of now, there is no reliable and simple method known for characterizing microcracks directly. At the same time, the effect of microcracks on the structure and the properties of ceramics can be evaluated indirectly from a measurement of their strength characteristics. The fact is that the beginning of rupture in a material is determined by the development level of microcracks [4, 5]. The author's experimental studies [6] on specimens with various ultimate compressive strengths (differing within 20-25%) have shown that, with other factors (chemical composition, porosity) equal, the thermal conductivity and diffusivity are directly proportional to the mechanical strength of work pieces.

These findings lead to the conclusion that a more complete characterization of specimens (in a study of their thermal conductivity and diffusivity) should include their mechanical strength as, for example, the rupture load in compression or bending. These parameters can be determined by standard methods without difficulty. The strength characteristics of work pieces are, evidently, also specified in the case of metals. Here the dislocations in test specimens are thus indirectly characterized.

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