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THERMOPHYSICAL AND STRUCTURAL INVESTIGATION OF Eu_2O_3 - Mo SYSTEM

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ABSTRACT

The paper presents the results of temperature dependence of thermal diffusivity of 3 composition Eu_2O_3 - Mo mixtures in temperature range (900 - 1300) K as well as the results of rtg. diffraction analysis. An anomalous temperature dependence of thermal diffusivity was found as a function of Mo concentration. In the case of Eu_2O_3 there exists the structure transformation from cubic to monoclinic phase at temperature 1323 K. It was found, that this change is not reversible. The monoclinic phase was observed also after cooling to room temperature. The content of Mo lowers substantialy the temperature of phase transformation of Eu_2O_3. The anomaly of temperature dependences of thermal diffusivity can be explained by different values of thermal parameters of cubic and monoclinic phase of Eu_2O_3, respectively.

INTRODUCTION

One of the important tasks of contemporary science and technology is the study of properties of high temperature resistant constructional materials. High melting point ceramics based on the rare earths oxides belong to this group of materials. There are used in mixture with high melting point metals in order to improve technological characteristics.

INVESTIGATION OF THERMAL DIFFUSIVITY

The results of experimental investigation of temperature dependence of thermal diffusivity a(T) of 3 mixtures Eu_2O_3 - Mo system are shown on figure 1. The compositions (in weight ratios), densities, porosities, characteristical temperatures T_c and the relative changes of $a(T_c)$ are presented in table 1. The values of thermal diffusivity are the mean ones from 4-8 experimental data. Systematical error of presented data is about 7 % and is determined by Bio criterion error, which criterion characterises the conditions of heat transfer from sample to surrounding. The Bio

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dence on porosity is more pronounced than the dependence on composition.

Measuring of a(T) was performed using the method of planar-temperature waves in temperature interval (900 - 1300) K by means of devices described in 1,2.

INVESTIGATION OF STRUCTURE

The structural investigation was performed by a routine powder diffraction method. The grain size of the Eu_2O_3 powder was about the value 10 μm. All the samples were annealed 3 hours at the temperature T (No. 2-7), except the sample No. 1. Table 2 presents annealing temperatures and the observed types of structure.

Table 2

No.:	1	2	3	4	5	6	7
T [K]	293	973	1073	1173	1273	1373	1873
Structure:	← cubic →					← monoclinic →	

It is known 3, that the temperature of phase transition from cubic to monoclinic of Eu_2O_3 is 1323 K. It is necessary to emphasize that samples No. 6 and 7 remained monoclinic down to room temperature at which the structure measurements were performed only. There were performed also the measurements on 4 samples prepared by cold pressing Eu_2O_3 with powdered Mo (the grain size about (10 - 15) μm) of weight ratio 0,68/0,32. These samples were annealed at temperatures 1073, 1133, 1153 and 1183 K in vacuum furnace. According to rtg. structural results all of them have the same structure. Detailed investigation has shown, that the sample annealed 1183 K contains cubic Mo and monoclinic Eu_2O_3. In contradiction pure Eu_2O_3 powder annealed at the same temperature (1183 K) is cubic (see table 2). From that fact an interesting conclusion results, that presence of Mo in mechanical mixture of Eu_2O_3 + Mo powders decreases the temperature of phase transition of Eu_2O_3 from 1323 K at least down to 1073 K.

CONCLUSIONS

The fact of influence of Mo on phase transition temperature of Eu_2O_3 , enables to interprete the anomaly of temperature decriterion was determined experimentally by means of phase-frequency method in which the original frequency of heat flux was doubled.

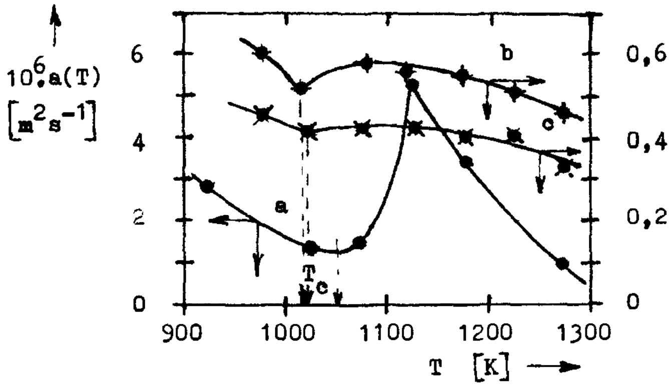

Fig. 1

The temperature dependences of thermal diffusivity of Eu_2O_3 - Mo system (a - 0,68/0,32/7465 kgm^{-3}; b - 0,50/0,50/6606 kgm^{-3}; c - 0,50/0,50/6394 kgm^{-3})

It can be seen from the picture that there exists an anomaly (a decrease with the following sharp increase of thermal diffusivity) in temperature dependence of thermal diffusivity for each of investigated mixture. Table 1 obtains characteristical temperatures of these anomaly T_c as well as the values of relative change of $a(T_c)$ for each investigated mixture. From table 1 and figure 1 it can be seen that thermal diffusivity of Eu_2O_3 - Mo mixtures depends substantialy on porosity of sample. This depen-

Table 1

Composition [-]	Density [kgm^{-3}]	Porosity [%]	Characteristical temperature T_c [K]	Relative change of $a(T_c)$ [%]
0,68/0,32	7465	7,7	1048	281,9
0,50/0,50	6606	23,0	1013	16,2
0,50/0,50	6394	25,0	1018	9,3

pendences of thermal diffusivity. This anomaly can be explained by the different thermal diffusivity of cubic and monoclinic phases of Eu_2O_3.

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