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A HIGH-TEMPERATURE HEAT SENSITIVE ELEMENT

Oguro, M.

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16. Abstract
This invention concerns the high-temperature heat sensitive element which is stable at high temperatures. A solid solution of the main component $MgO-Al_2O_3-Cr_2O_3-Fe_2O_3$ which contains spinel crystal structure is mixed with the secondary component ZrO_2 at the mol ratio of 100 : 0.1-5.0 and sintered to prepare a high-temperature heat sensitive element.

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A HIGH TEMPERATURE HEAT SENSITIVE ELEMENT

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A HIGH TEMPERATURE HEAT SENSITIVE ELEMENT

Patent Publication #54-104599

1. Name of the invention

A high temperature heat sensitive element

2. Scope of the patent application

Solid solution of the main ingredient $MgO-Al_2O_3-Cr_2O_3-Fe_2O_3$ ** which contains spinel crystal structure is mixed with the secondary ingredient ZrO_2 at the mol ratio of 100 : 0.1 - 5.0 and sintered in order to prepare the high temperature heat sensitive element.

3. Detailed explanation of the invention

This invention concerns the high temperature heat sensitive element which is stable at high temperature.

Along with the rapid development in electronics and related fields, development and practical application of materials for thermistors such as spinel crystal system, herobskite ** crystal system and $ZrO_2-Y_2O_3$ group that can be used at the high temperature of 1000 degrees C or so has been seriously discussed.

For example, recently built automobiles are equipped with catalytic converters which help the complete combustion of automobile exhaust gases (CO, nitrogen oxide, hydrocarbon) as a part of the measures to clean up the automobile exhaust. It is necessary to detect the temperature of the interior of the catalytic converter for the purpose of preventing the possibility of abnormal overheating of the converter. Lately, thermal reactors are widely used to do the job described above.

The stable range of the spinel crystal system thermistor material, MgO-Al2O3-Cr2O3-Fe2O5, which has been in use for a long period of time is severely limited as far as its high temperature load is concerned. Stabilized manufacturing of the same has been very difficult.

The objective of this invention is to overcome the above described shortcoming and to provide a high temperature heat sensitive element which shows stable characteristics toward high temperature load.

The following practical applications of this invention are explained.

First, the main ingredient, $Mg(Al_xCr_yFe_x)_2O_4$ [x + y + z = 1, x; 3 - 4, y; 5 - 6, z; 1 - 2] is mixed with ZrO2 at the mol ratio of 100 : 1. The mixture is provided additional mixing, temporary sintering and grinding. After drying the mixture, it is added with polyvinyl alcohol and made into granules. Then, platinum lines (as identified in the numerical key 2 in Fig. 1) are buried, and the object is shaped as shown in Fig. 1. In Fig. 1, the numerical key 1 indicates the thermistor before sintering, and the key 2 indicates the platinum lines as mentioned earlier. Once shaping of the thermistor is completed, it is sintered for 3 - 5 hours at above 1600 degrees C temperature. Fig. 2 shows the resistance figures of the thermistor within 900 degrees C temperature that is indicated within the triangle ABC. As the figures of x, y and z slip off the following guideline [x; 3 - 4, y; 5 - 6, z; 1 - 2], the resistance figure becomes too high. Products with excessively high resistance figure are not suitable for practical application. Fig. 3 shows as an example the temperature - resistance characteristics of thermistors prepared from a number of test materials. The linear characteristics of the constant B is a little off, however, it presents no problem in practical use.

Next, the volume of ZnO2 additive was changed, and the change (fluctuation) ratio in the resistance figure by the high temperature life ** at the time was examined. The result of the examination is shown in Fig. 4. In case ZrO2 is not added, the change (fluctuation) ratio of the resistance figure at the high temperature load is significantly high. In addition, the higher the volume of the additive is, the higher the change (fluctuation) ratio of the resistance figure is. When the figure in contrast to the main ingredient is greater than 100 : 5 in mol ratio, the change (fluctuation) ratio nears 10 %, and the effect of the additive becomes less significant.

As an example among many samples which were sintered after adding ZrO2 in the ratio of [100 : 0.1 - 5.0] in reference to the main ingredient in mol ratio, the time lapse change up to 1000 hours has been examined by impressing DC 2 V, 900 degrees C and DC 3V, 1000 degrees C. The result is shown in Fig. 5 and Fig. 6.

As clearly shown by the examples described above, through adding ZrO_2 to the spinel crystal system MgO-Al_2O_3-Cr_2O_3-Fe_2O_5 thermistor material, the high temperature load life is significantly improved. Accordingly, the high temperature heat sensitive element that can be put to practical application can be manufactured.

4. Brief explanation of figures

Fig. 1 is a frontal plane view of the high temperature heat sensitive element by this invention during its production. Fig. 2 shows the relationship between the composition and the resistance figures of the same element. Fig. 3 shows the temperature - resistance characteristics of the high temperature heat sensitive element. Fig. 4 shows the relationship between the volume of ZrO_2 additive and the change (fluctuation) ratio of the resistance figure. Fig. 5 and Fig. 6 shows the time lapse change in the high temperature load endurance of the same element at 900 degrees C, DC 3V and 1000 degrees C, DC 2V.

Fig 1
第 1 図

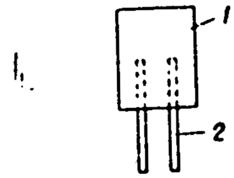
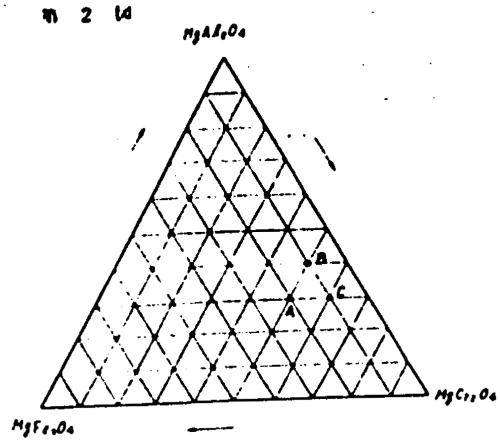
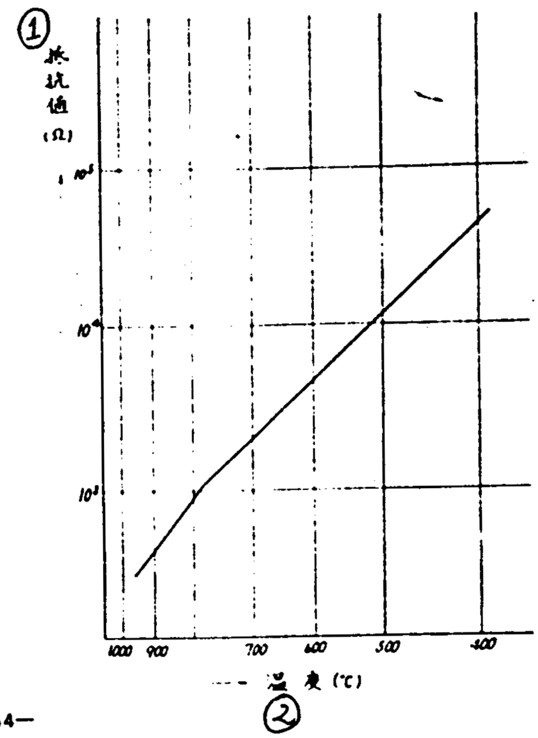


Fig.2
第 2 図

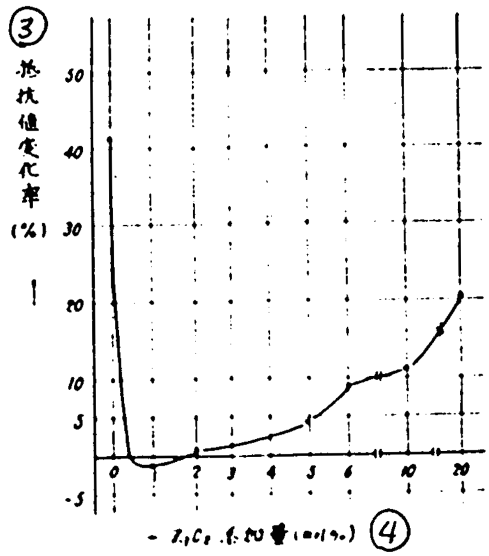


A : 190Ω
B : 1800Ω
C : 7000Ω

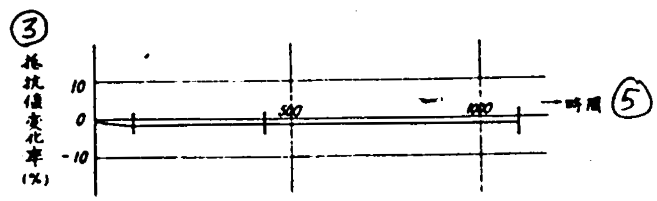
第 3 図 Fig.3



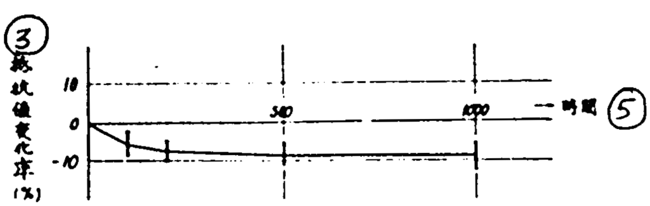
第 4 図 Fig.4



第 5 図 Fig.5



第 6 図 Fig.6



Key list: 1. resistance 2. temperature 3. resistance figure change (fluctuation) ratio 4. volume of ZrO_2 additive

5. time