

## HEAT-GENERATING RESISTOR AND HEAT-GENERATING RESISTANCE ELEMENT USING SAME

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to a heat-generating resistor and a heat-generating resistance element by use of the heat-generating resistor, particularly to a thin film heat-generating resistor having a resistance thin film as the functional element on a substrate surface and a heat-generating resistance element by use of the heat-generating resistor.

Such a resistor can be used suitably as an electricity-to-heat energy converting element in various electronic instruments and electrical instruments.

#### 2. Description of the Prior Art

In the prior art, the heat-generating resistors employed as relatively small electricity-to-heat energy converting elements in electronic instruments or electrical instruments may include the thin film type, the thick film type and the semiconductor type. Among them, the thin film type can be smaller in power consumption as compared with other types and also relatively better in heat response, and therefore tends to be increasingly applied.

The performances demanded for such a heat-generating resistor are good response of heat generation to a certain electrical signal, good thermal conductivity, good heat resistance to heat generation by itself and various durabilities (e.g. durability against heat history).

And, in the thin film type heat-generating resistors, the above performances have not been satisfactory and further improvements of the characteristics are desired.

### SUMMARY OF THE INVENTION

In view of the prior art as described above, an object of the present invention is to provide a thin film heat-generating resistor improved in heat response and a heat-generating resistance element employing the resistor.

Another object of the present invention is to provide a thin film heat-generating resistor improved in thermal conductivity and a heat-generating resistance element employing the resistor.

Still another object of the present invention is to provide a thin film heat-generating resistor improved in heat resistance and a heat-generating resistance element employing the resistor.

Still another object of the present invention is to provide a thin film heat-generating resistor improved in durability and a heat-generating resistance element employing the resistor.

It is also another object of the present invention to provide a thin film heat-generating resistor improved in chemical resistance, flexibility and mechanical characteristics and a heat-generating resistance element employing the resistor.

Further object of the present invention is to provide a heat-generating resistor which has made various characteristics such as heat accumulability, heat dissipability, adhesion of the substrate to the functional thin film easily realizable, and a heat-generating resistance element employing the resistor.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 and FIG. 2 are partial sectional views of the heat-generating resistor of the present invention.

FIG. 3 is an illustration of the device to be used for preparation of the heat-generating resistor of the present invention.

FIG. 4 is a partial sectional view of the heat-generating resistance element prepared in Example 1 of the present invention.

FIG. 5 to FIG. 10 are graphs showing distribution of the content of a substance selected from halogen atoms, hydrogen atoms, silicon atoms, germanium atoms and substances for controlling electroconductivity in the functional thin film.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, the present invention is described in more detail.

FIG. 1 is a partial sectional view showing the construction of an embodiment of the heat-generating resistor of the present invention.

In this FIG. 2 is a substrate and 4 is a thin film for realizing functionality, namely resistance.

The material for the substrate 2 is not particularly limited in the present invention, but it is practically preferable to use a material which has good adhesion to the functional thin film to be formed on its surface, and also has good resistance to heat during formation of the functional thin film 4 and to the heat generated on the functional thin film during usage. Also, the substrate 2 should preferably have an electrical resistance greater than the functional thin film to be formed on its surface. Further, in the present invention, depending on the purpose of use of the resistor, a substrate 2 with small thermal conductivity or great thermal conductivity may be used.

Examples of the substrate 2 to be used in the present invention may include those comprising inorganic materials such as glass, ceramic, silicon, etc. and organic materials such as polyamide resin, polyimide resin, etc.

In the present invention, the functional thin film 4 comprises an amorphous material containing halogen atoms and hydrogen atoms in a matrix of carbon atoms. As halogen atoms, F, Cl, Br, I and the like can be utilized, and these may be used either singularly or in combination. As halogen atoms, particularly F and Cl are preferred, and above all F is preferred.

The content of halogen atoms in the functional thin film 4 may be suitably selected depending on the purpose of use of the resistor so that desired characteristics may be obtained, but it is preferably 0.0001 to 30 atomic %, more preferably 0.0005 to 20 atomic %, optimally 0.001 to 10 atomic %.

The content of hydrogen atoms in the functional thin film 4 may be suitably selected depending on the purpose of use of the resistor so that desired characteristics may be obtained, but it is preferably 0.0001 to 30 atomic %, more preferably 0.0005 to 20 atomic %, optimally 0.001 to 10 atomic %.

The sum of the content of halogen atoms and hydrogen atoms in the functional thin film 4 may be suitably selected depending on the purpose of use of the resistor so that desired characteristics may be obtained, but it is preferably 0.0001 to 40 atomic %, more preferably 0.0005 to 30 atomic %, optimally 0.001 to 20 atomic %.