Highly Thermal Conductive Mica Insulating Tape for Large-Capacity Generator

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1 Abstract

Electricity demand is tending to increase worldwide and thermal power generation is a mainstream means of generating power. Generally, a water direct cooling system is used for a large-capacity turbine generator, but the cooling structure including the waterway is complicated, so an indirect hydrogen cooling system without a waterway is expected for a large-capacity turbine generator. When the highly thermal conductive mica insulating system would be applied to hydrogen cooling generators, it is possible to expand power capacities of generators. In this paper, I report the development of a mica insulating tape indicating the thermal conductivity 2 times higher than the conventional products.

2 Characteristics of the product

- Thermal conductivity twice as high as conventional tape.
- Development of 2 types of highly thermally conductive insulating tape including dry type for vacuum pressure impregnation other than prepreg.

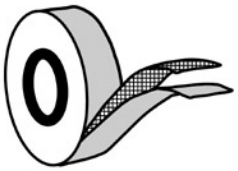
3 Background of the development

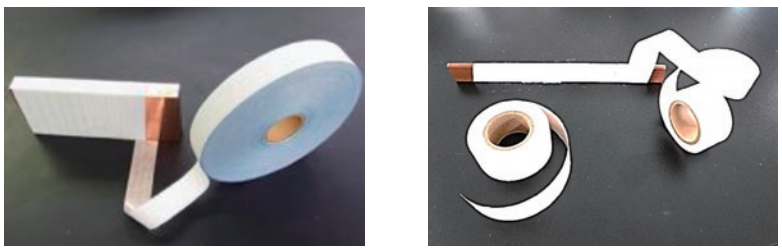
Our company has been engaged in development works in both fields of resin and filler for insulation material with highly thermal conductivity by focusing on the development of insulating adhesive sheet and other products for use in power device[2]. During the development process, we established a technology for self-aligning epoxy resin during curing process with high thermal conductivity, and filler dispersion technology to optimize balance between thermal conductivity and insulation property with a trade-off relationship with thermal conductivity. Then, with the intention to break into the field related to social infrastructure, we promoted studies on thermal conductivity improvement for mica insulating tape to be used in a generator, which was selected as a target and our highly thermally conductive material technology can be helpful. Especially since high level insulation of mica insulating tape is required for applications in a generator; filler shape was optimized and homogeneous dispersion technology was developed and applied to prevent electric field concentration.

4 Details of the technology

(1) Material design concept

Mica insulating tape has a two-layer structure constituted of a mica layer and a glass cloth impregnated with resin as shown in **Figure 1**.





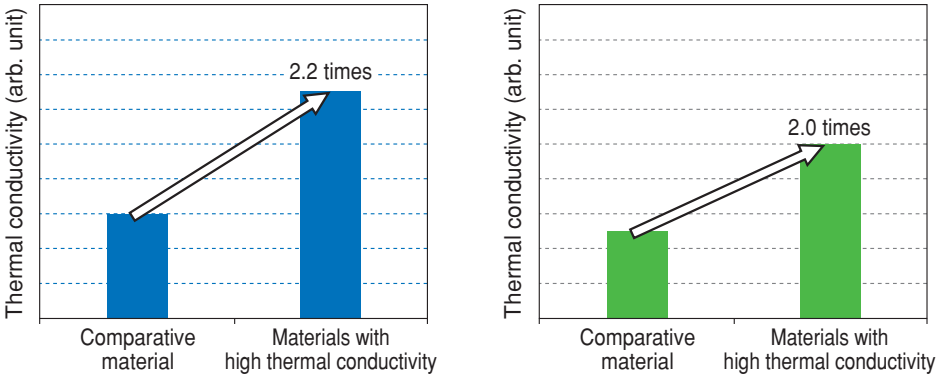
(a) Prepreg tape (b) Dry tape

Figure 1 Developed highly thermal conductive mica insulating tapes

Prepreg tape as shown in **Figure 1(a)**, wherein mica layer is fully impregnated with resin, shall be wound around a coil multiple times, then directly used for fabrication by press molding and curing. On the other hand as shown in **Figure 1(b)**, dry tape, which is not impregnated with resin, shall be wound around a coil multiple times, immersed in low viscosity resin solution, impregnated with resin under vacuum-pressure, then used for fabrication by press molding and curing. Our company developed two types (prepreg and dry type) of mica insulating tapes with high thermal conductivity to meet needs of both processes.

(2) Characteristics of the material

Sixteen layered cured prepreg and dry tape insulating laminates were prepared and thermal conductivity of both cured insulating laminates were measured by steady state thermal conductivity measurement method with results shown in **Figure 2**. We confirmed levels of thermal conductivity of both cured insulating laminates were twice as high as that of comparative insulating laminate having the same structure using conventional tape, to which, however, our highly thermally conductive resin technology was not applied. Both prepreg and dry tape cured insulating laminates had the same level of insulating performance as that of the comparative laminate.



(a) Cured prepreg tape insulation laminate　　(b) Cured dry tape insulation laminate

Figure 2 Thermal conductivities of cured mica insulating laminates

5 Future Business Development

・Development of tapes having 5 times higher thermal conductivity using high thermal conductive self-aligning epoxy resin

【References】

1) Hiroaki Tomiki et al., Toshiba Review 65 (2), pp.48-51 (2010)

2) Yoshitaka Takezawa, Hitachi Chemical Technical Report, 53, pp.5-10 (2009)