New Development of High Heat Resistance and Low Dielectric Thermosetting Resin, "S. F. Resin"

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1 Abstract

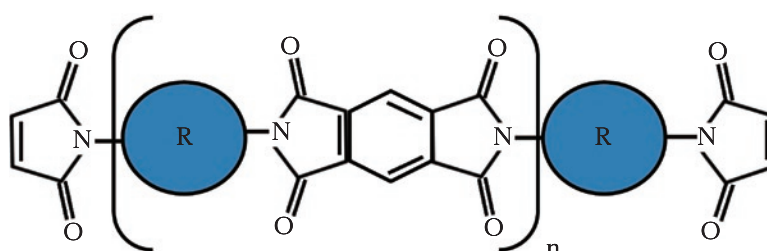
In recent years, thinning of devices and components has led to a problem of warping, which may reduce connection reliability. Low elastic resin material has attracted attention as a possible solution. However, its application range, typified by acrylic resins, is limited, due to low thermal decomposition temperature. New "S. F. Resin" has low elasticity, high heat decomposition temperature, low dielectric constant, low moisture absorption rate, and many other excellent characteristics. These properties contribute to the development of a "no warp" heat-resistant temporary fixing material, laminating adhesive, high frequency corresponding material, moisture-proof coating agent, and buffer coating agent.

2 Characteristics of the Product

- Has low elasticity, high thermal decomposition temperature, low dielectric characteristics, and a low moisture absorption rate.
- Has self-polymerizable characteristics by peroxide and UV, and reactivity with epoxy resin.
- By addition to film materials, etc., the product achieves low elasticity, low dielectric characteristics, and low moisture absorption rate without lowering heat resistance.

3 Background of the Development

In recent years, the thinning of devices and components has led to the problem of warping in various fields: such as warping of heat resistant fixing materials, laminating adhesives, high frequency corresponding materials, moisture-proof coating agents, and buffer coating agents. Although one solution for the warping problem is to reduce the elasticity of laminated materials, low elasticity resin so far represented by acryl resin had the problems of moisture absorption and thermal decomposition. Therefore, we developed an "S.F. resin" to achieve low elasticity, a high thermal decomposition temperature, a low dielectric constant, and a low moisture absorption rate by combining maleimide resin, which provides excellent heat resistance, and a skeleton of low elasticity and low moisture absorption, and started examining its application to various fields.



R: Structure of low elasticity and low moisture absorption skeletal resin

Figure 1 Structure of "S. F. Resin"

4 Technical Details

"S.F. resin" is composed of a base of the maleimide imide group, which provides excellent heat resistance, and the skeleton of low elasticity and low moisture absorption. "S.F. resin" thereby achieves low elasticity, a high thermal decomposition temperature, a low dielectric constant, and a low moisture absorption rate. The general properties of a resin film thermoset after adding peroxide to the "S.F. resin" are shown below (**Table 1**). Although thermoset "S.F. resin" has an elastic modulus as low as 0.08 GPa at normal temperature, it has excellent heat resistance with a 5% thermal decomposition temperature of 435°C (**Figure 2**). In addition, the

thermoset “S.F. resin” shows the dielectric characteristics of a specific dielectric constant of 2.4 and a dielectric loss tangent of 0.0018 at 10 GHz, which are almost equivalent to those of the LCP substrate material (**Figure 3**). We are developing temporary fixing materials with high heat resistance for glass processing (using high heat resistance and low elasticity). We are also developing low transmission loss materials for millimeter-wave radar, utilizing low dielectric characteristics.

Table 1 Properties of “S. F. Resin”

Item	Condition	Unit	S.F. Resin	Material A	Material B	Material C*2
Resin System		—	Bismaleimide	Acryl	Soluble Polyimaide	LCP
Dk (10GHz) *1	A	—	2.4	2.9	3.3	3.0*3
Df (10GHz) *1	A	—	0.0018	0.0240	0.0200	0.0020*3
CTE (X-Y)	< Tg	ppm/℃	120	110	100	—
	> Tg	ppm/℃	180	—	—	—
Tg	TMA	℃	84	160	185	—
Elastic Modulus	DMA	GPa	0.08	0.40	0.70	3.40
Td	TGA-1%loss	℃	375	250	300	—
	TGA-5%loss	℃	435	320	350	—
Peel Strength	Low Profile	kN/m	1.6	1.8	1.8	0.7
Water absorption	D-23/24	%	0.05	0.3	0.8	0.05
Dielectric breakdown voltage	1mm, 25℃	kV/mm	30	22	30	—
	1mm, 150℃	kV/mm	30	—	—	—

*1 Cavity resonator perturbation method *2 Catalog value *3 Strip-line method

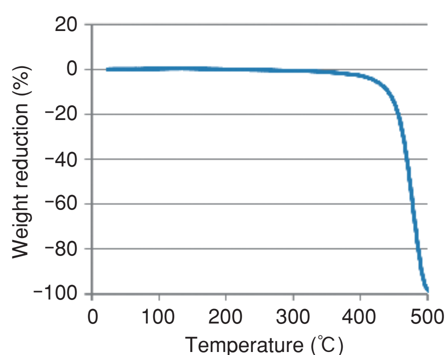


Figure 2 Measuerment of TGA

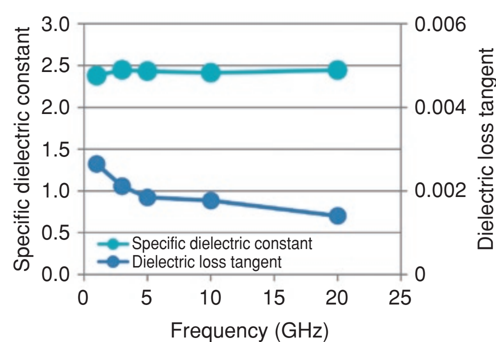


Figure 3 Dielectric property

5 Future Business Development

・Develop highly heat resistant temporary fixing material for glass processing
・Develop low transmission loss material for millimeter-wave radar
・Develop additives for composite materials
・Develop buffer coating film

【Reference】

1) Yoshihiro Nakamura: “Technology Trends and Future History of Semiconductor Packaging Substrate Material.” Hitachi Chemical Technical Report No. 55 (2013)