

# Next Generation Molding Compound GE-110 Series for BGA

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## 1 Abstract

Regarding the HAST (Highly Accelerated temperature and humidity Stress Test) failure by Cl ion with Cu wire<sup>1-3)</sup>, we established the method for ion mobility checking in molding compound by dielectric dispersion evaluation and then we confirmed the correlation between ion mobility and HAST failure. In addition, we can improve the HAST performance with using ion mobility control by resin structure optimization. And regarding the warpage control for thin package, we can improve the warpage to use the CTE (Coefficient of Thermal Expansion) control technique by installing new additive.

We developed the GE-110 series with using these ion mobility control technique and CTE control technique for Cu wire apply and thin package apply as new generation molding compound for BGA.

## 2 Product Features

- Prevention of corrosion caused by Cl ions produced in HAST by controlling the ion mobility in resin and applying this technique to copper wire packages
- Control of the coefficient of thermal expansion of resin by applying a material to control thermal expansion and decrease the warpage of thin packages

## 3 Background of Development

We developed a technique to reduce viscosity using polymer material and organic-inorganic composite technologies. This technique was applied to the GE-100 Series, and the excellent flow property of wire and good continuous formability they feature have contributed to a high market share for BGA molding compounds. However, it is difficult to apply the current GE-100 Series to the copper wire increasingly used recently in place of gold wire, and warpage of thinning molding packages.

The use of copper wire requires measures to prevent corrosion caused by Cl ions<sup>1,3)</sup>. The current solution involves adding an ion trap material with high chlorine trapping capability<sup>4)</sup>, but this technique tends to hinder the flow property and formability. The issue is how to maintain the latter properties while applying this technique. To prevent warpage of thin packages, both at room temperature and during the reflow process, Coefficients of thermal expansion of resin CTE1 and CTE 2 need to be controlled separately, suggesting that the problem is not solved by simply adjusting the filler volume.

We developed a next-generation molding composite GE-110 Series for BGA using newly developed resin ion mobility control and thermal expansion control technologies and adapting to copper wire and warpage of thin packages.

## 4 Product Design

### (1) Controlling the ion mobility in resin

**Figure 1** shows the master curves obtained when measuring dielectric relaxation (reference temperature: 165°C), where the absolute dry condition at 165°C is equivalent to the iso-free volume fraction of a water absorption of 0.3 wt% at 130°C. In **Figure 1**, the peak in frequency range between  $10^{-3}$  and  $10^2$  Hz is associated with the molecular motion in the side chain of the resin. It is assumed that ions move with this molecular motion in the side chain. In GE-110, the peak is seen in a lower frequency range than that in GE-100, and ion mobility is obviously slow as intended in the design. Ion mobility in the GE-110 Series is controlled by increasing the Tg (glass transition temperature) of resin and decreasing water absorption with a special additive.

## (2) Controlling the thermal expansion of resin

The additive used to reduce water absorption was found to be capable of adjusting CTEs, increasing CTE1 and slightly decreasing CTE2 by forming a domain in resin. Accordingly, it proved effective for improving the mismatch of thermal expansions of substrate and resin, and suppressing warpage of thin packages. **Table 1** lists the properties of resins.

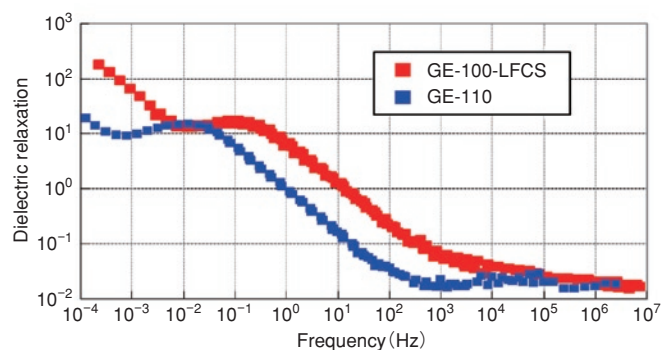


Figure 1 Dielectric dispersion 165°C

Table 1 Comparison of GE-100 series and GE-110 series

Item	GE-100-LFCS	GE-110-LS
Epoxy	Biphenyl	Biphenyl
Filler Content (wt%)	88.5	85.0
Additive for lowering moisture	None	Added
Spiral Flow (cm)@175°C	185	230
Gel Time (sec)@175°C	45	39
CTE1 (ppm)	9	11
CTE2 (ppm)	39	40
Tg (°C)	143	151
Moisture absorption (wt%) @130°C, 85%RH	0.31	0.3
pH	5.6	5.6
Cl <sup>-</sup> (ppm)	13	10

## 5 Future Prospects

- Global marketing of the GE-110 Series
- Application to compression corresponding and mold underfill materials

### [References]

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- 2) H. J. Kim, J. Y. Lee, et al., Effects of Cu/Al Intermetallic Compound (IMC) on Copper Wire and Aluminum Pad Bondability, IEEE TRANSACTIONS ON COMPONENTS AND PACKAGING TECHNOLOGIES, Vol. 26, No. 2, JUNE 2003
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