Granule-Type Encapsulating Compound for Compression Molding

Mitsuaki Fusumada *Dongchul Kang* *Takehiro Masubuchi*

Encapsulation Materials R&D Dept.,
Electronics-related Materials Development Center,
R&D Headquarters

1 Abstract

In recent years, studies have been conducted on compression molding because of its potential to reduce costs through the miniaturization and slimming down of semiconductor packages, and through batch molding (achieved via enlargement).

With compression molding, a powder-type encapsulating material is supplied directly into the mold cavity, decompressed, and then molded. As such, it is necessary to control the shape of the encapsulating material in order to prevent fluctuations in the resin thickness resulting from equipment contamination or from weight variation.

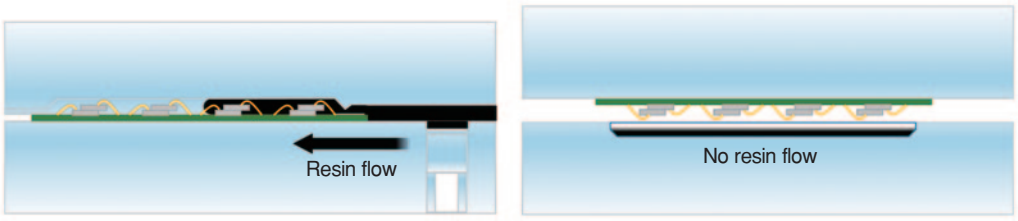
We have developed a method for producing a granule-type encapsulating compound that has a sharp particle-size distribution, and have also studied the compound's de-foaming property, which helps suppress resin leakage during decompression. By combining these technologies, we have developed a granule-type encapsulating compound for use in compression molding.

2 Characteristics of the Product

- Fine powder control reduces the contamination of equipment due to spraying powder and improves productivity.
- A uniform granule size improves the precision of package thickness.
- The introduction of de-foaming technology helps suppress resin leakage during molding.

3 Background of the Development

In recent years, studies have been conducted on compression molding for semi-conductor packages because of its potential to reduce costs through batch molding and its applicability to larger circuit boards and slimmer packages. With compression molding, a powder-type encapsulating material is used and resin is supplied directly into the mold cavity. As such, it is necessary to control the shape of the encapsulating material in order to prevent fluctuations in the resin thickness resulting from equipment contamination or from weight variation. To address this need, we developed a method for producing a granule-type encapsulating compound that has a sharp particle-size distribution. Another issue we needed to address was resin leakage caused by the foaming of the encapsulating compound during decompression and de-foaming, processes that are required for compression molding. To tackle this issue, we introduced foam-suppression technology to create a new encapsulating compound for compression molding.



Transfer molding
(Decompression and de-foaming after mold clamping)

Compression molding
(Decompression and de-foaming prior to mold clamping)

Figure 1 Method for encapsulating semiconductor packages

4 Technical Details

1. Method for producing a granule-type encapsulating compound

The fine powder in granule-type encapsulating compounds consist mainly of powder created during manufacturing and powder created as a result of the chipping and scraping that occurs during transport within equipment or during weighing by the vibration feeder. First, we studied the manufacturing methods and the conditions required to achieve a sharp particle-size distribution. As a result, we were able to control the granule particle-size distribution to between 0.4 mm and 1.2 mm, and to

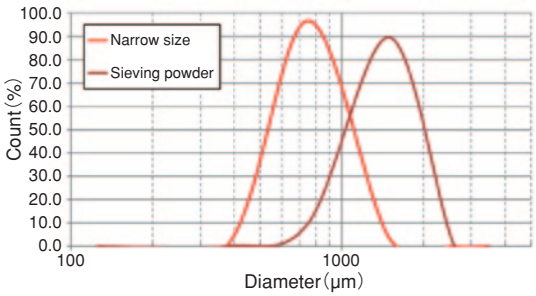
reduce chipping of the granules by improving the uniformity of the granule surface. We were able to verify that granules produced by using this method maintain stable dimensions and generated less fine powder.

2. Resin leakage

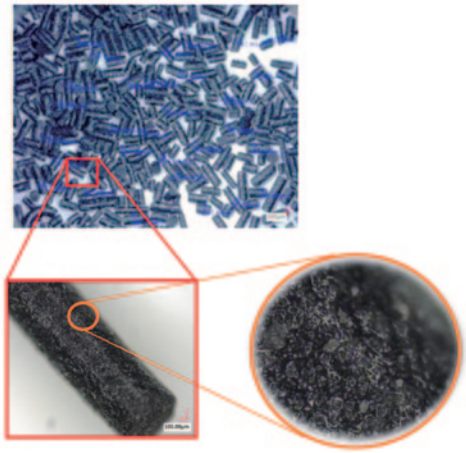
During decompression, gas trapped between the granule particles, and the volatile components of the encapsulating compound expand. This causes the compound to foam and its volume to increase, which in turn causes resin to leak from the mold.

In other words, to control resin leakage, we need to limit the amount of volatile components and to quickly remove trapped gas during decompression. Conventionally, resin leakage was suppressed by raising the melting point of the encapsulating compound, thereby allowing gas to escape from between the particles. However, an increased melting point sometimes led to wire deformation. Similarly, because the granule particles no longer melted easily, the external appearance of particle surfaces was poor.

Our new de-foaming technology rapidly breaks up foam that forms in the encapsulating compound, facilitating the release of trapped gas and volatile components and thus suppressing foaming and an increase in the volume of the encapsulating compound. The new material that we produced by using this method has been praised by customers for its low resin leakage and extremely low viscosity.

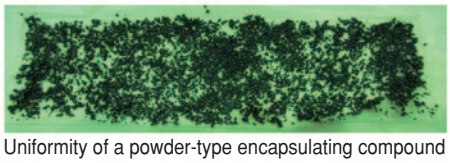


Comparison of the particle size distribution between granules and powder

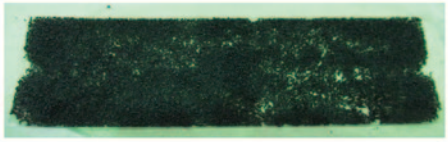


Surface of a granule

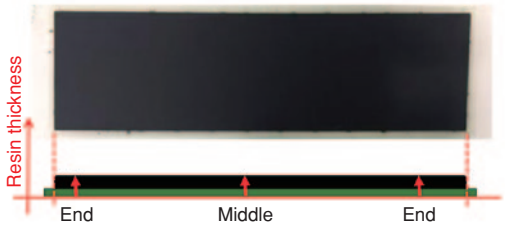
Figure 2 Granule particle distribution and the surface of a granule

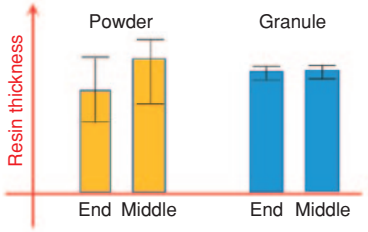


Uniformity of a powder-type encapsulating compound



Uniformity of a granule-type encapsulating compound

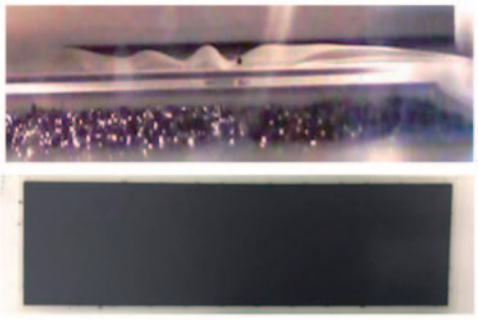




Comparison of dimensional stability

Figure 3 Molding results

Resin leakage due to foaming



Resin leakage suppressed by the compound's de-foaming property

Figure 4 Evaluation of resin leakage when using the new compound

5 Future Business Development

- Sales promotion of developed material
- Further miniaturization
- Application of developed technologies to produce encapsulating compounds with high thermal conductivity and mold underfill materials