

Ultra-Low Warpage and Excellent Filling Ability Liquid MUF for Advanced Fan-Out Wafer Level Package

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The long-running trend for semiconductor devices to exhibit increased performance while simultaneously reducing form factor has accelerated in recent years. Fan-out wafer level packaging (FOWLP) is one of the leading-edge designs that is projected to grow significantly in the near future.

The resin formulation of the epoxy molding compounds (EMC) used in FOWLP is very important because the material properties greatly impact the performance and reliability of the device. To meet these demands, EMCs with improved capabilities such as low loss characteristics and high thermal performance are required. To exacerbate the challenges, these package structures tend to have increasingly high I/O counts to enable higher functionality while the interconnect pitches decreases to reduce the package footprint. Additionally, a demand for fan-out Wafer Level System in Package (WLSiP) is emerging to integrate multiple semiconductor die into a single package. As these package designs evolve, the reduction of package warpage and void-free filling of the decreasingly narrow gap under the IC is becoming an increasingly pressing issue. Liquid capillary underfill (CUF) materials have long been used to fill this space. The CUF is dispensed around the perimeter of the die (normally on two sides) and flows under the die and around the interconnect structures via capillary action. After the CUF has fully filled the interstitial region, the material is

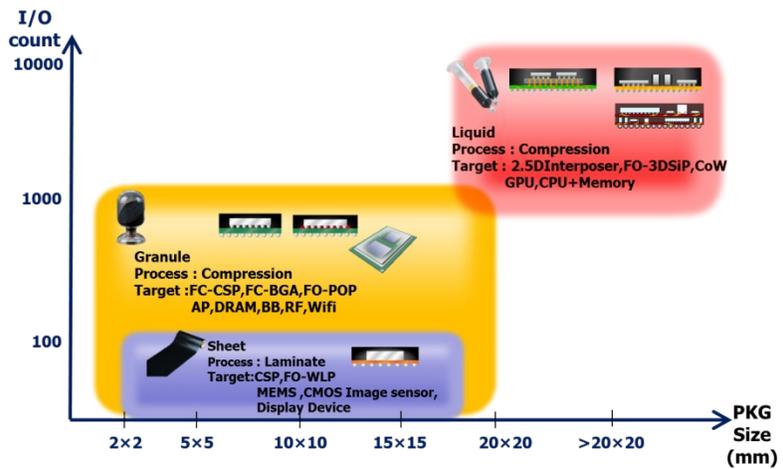


Fig1. Position of encapsulation material

thermally cured, and the device is subsequently overmolded with EMC. However, this two material/two-process method is less effective in terms of productivity. The researchers have developed a liquid molded underfill (MUF) material that accomplishes underfilling and molding simultaneously. This material exhibits ultra-low warpage and excellent filling ability required by high-density FOWLP designs. This presentation reviews (1) the effect of resin viscosity

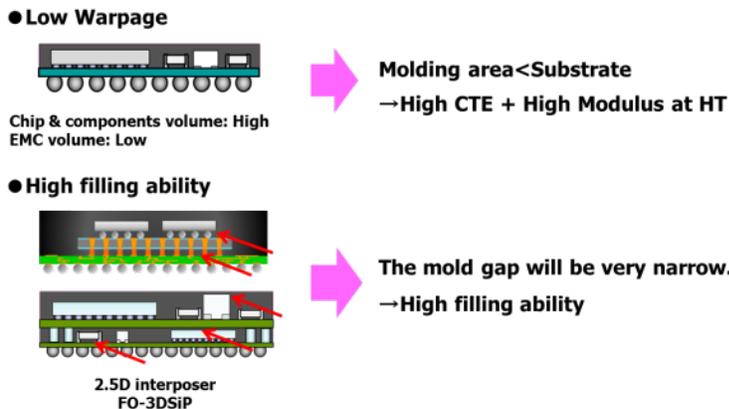


Fig2. Characteristics required for MUF

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and filler particle size/distribution on filling ability, (2) the effects of coefficient of linear expansion of resin, modulus and curing shrinkage on warpage, and (3) the effect of curing conditions on resin shrinkage rate and warpage. The research demonstrated that low package warpage and complete filling or gaps less than 10 microns can be achieved with this liquid MUF material.

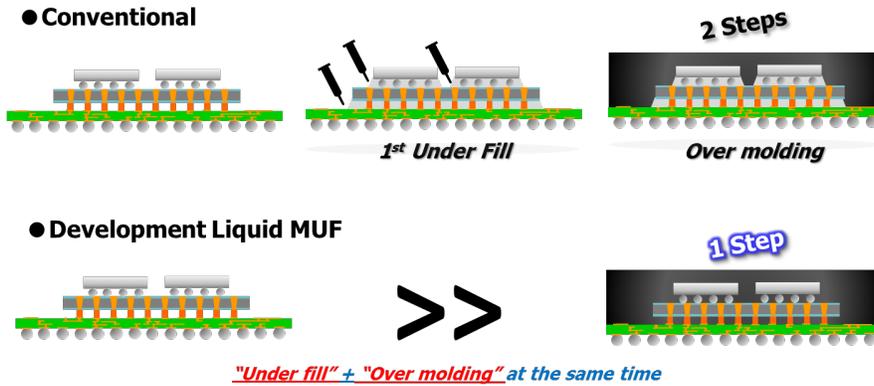


Fig3.Process of Liquid MUF

Please visit our website for details

The screenshot shows the Panasonic website interface for the Liquid Molded Underfill product. The navigation bar includes links for Products, Application Guides, Download, Design Support, News, and Contact us. The breadcrumb trail reads: Panasonic > business > Industrial Devices & Solutions > Electronic Materials > Products > Liquid Molded Underfill. The main heading is "Liquid Molded Underfill for 2.5D, SiP". A navigation menu below the heading includes Electronic Materials, TOP, Products, Downloads, Exhibition, News, About us, and Location. A large graphic features the text "One Step Underfill + Over molding" next to a 3D illustration of a component with underfill. Below the graphic, the text states: "Panasonic Molded Underfill (MUF) materials enable faster packaging cycle times." Three green buttons highlight the benefits: "One Material - One Process", "High filling ability", and "Low Warpage".