

# Photosensitive Insulation Film, “PV series”

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## 1 Abstract

In recent years, the growing need for more advanced, miniaturized package substrates calls for higher-density wiring. Vias for connecting the layers of these substrates are traditionally formed by using CO<sub>2</sub> laser ablation technology. Generally, this technology is only capable of producing vias of 40 μm in diameter or larger. This limitation on the via diameter is an obstacle to achieving finer wiring. To address the demand for finer wiring, we have developed a photosensitive insulation film, called the PV series.

The PV series is capable of forming vias as small as 15 μm in diameter, and can form multiple interlayer vias through a photolithography process involving one-shot exposure. Furthermore, the PV series can be applied to the manufacturing of package substrates without requiring any additional processes. As such, the PV series makes it possible to manufacture highly advanced, miniaturized package substrates that offer high throughput and superior reliability.

## 2 Characteristics of the Product

- Capable of forming interlayer connecting vias 40 μm or less in diameter at once.
- Contributing to densification of package substrates without introducing special processes.
- Having excellent insulation reliability and reflow heat resistance and expressing high reliability.

## 3 Background of the Development

The number of interlayer connecting vias in the work area hereafter tends to increase due to the wiring densification of package substrates. The interlayer insulation film material to be used forms interlayer connecting vias by irradiating with a CO<sub>2</sub> laser. Since it is generally difficult to form vias of 40 μm or less in diameter by the laser, a problem arises against densification of wiring as the increase in the number of vias accompanies the increase in the processing time. Then we developed a photosensitive interlayer insulation film called the PV series by combining our proprietary photosensitive resin technology and insulation resin technology. The advantage of the developed PV series is shown in **Figure 1**. Upon the development of the PV series, we fused our proprietary photosensitive resin technology and insulation resin technology in response to the densification by implementing the general package substrate manufacturing processes.

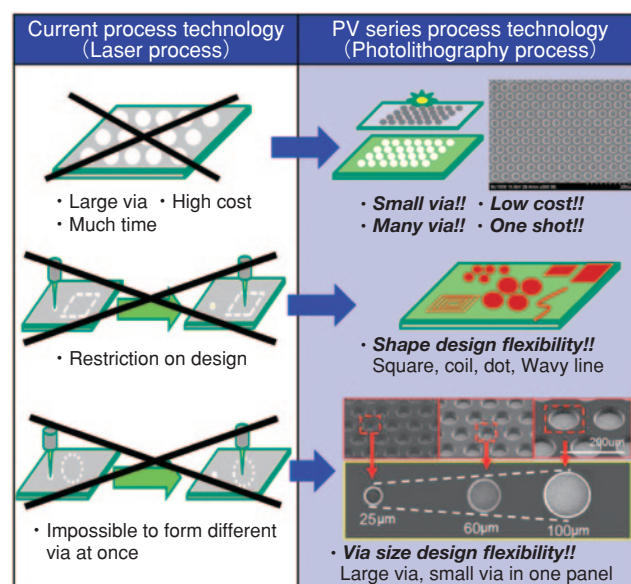


Figure 1 Advantage of PV series

## 4 Technical Details

### (1) Via opening characteristics of PV-F008

The developed PV-F008 can form vias with a small diameter of 15  $\mu\text{m}$ , which are difficult to form by  $\text{CO}_2$  laser. In addition, non-circular vias represented by square vias can be processed at once (**Figure 2**), and the via processing time can be reduced significantly.

### (2) General characteristics of PV-F008

The PV-F008 is suitable for the semi-additive construction method in addition to the photolithography. **Table 1** shows the general properties of the PV-F008. The via shape of the PV-F008 is represented by top/bottom sizes of 50  $\mu\text{m}$ /40  $\mu\text{m}$ , and PV-F008 has excellent via forming ability. In addition, the high adhesion (0.6 kN/m) of PV-F008 with electroless plated copper enables the suppression of the peeling of the wiring at the time of fine wiring patterning. Furthermore, reflow heat resistance of a multi-layer substrate assumed to be a package substrate and high insulation durability in a line and space of 12  $\mu\text{m}$  and 12  $\mu\text{m}$ , respectively, and an interlayer space of 15  $\mu\text{m}$  are excellent.

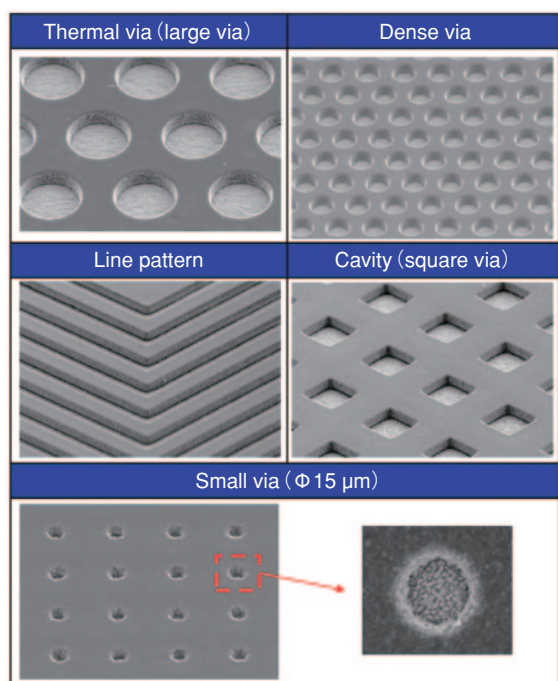


Figure 2 Photolithography of PV-F008

Table 1 Properties of PV-F008

Item		Unit	PV-F008
Minimum via	Resin thickness 10 $\mu\text{m}$	$\mu\text{m } \Phi$	15
Via size (Top / Bottom)	$\Phi$ 50 $\mu\text{m}$ target	$\mu\text{m } \Phi$	50 / 40
Insulation reliability (HAST 130°C, 85% RH)	Layer to layer (15 $\mu\text{m}$ )	200 h	Pass
	Line / Space=12 / 12 $\mu\text{m}$	200 h	Pass
TCT resistance	-65°C $\leftrightarrow$ 150°C	1000 cycle	Pass
Reflow cycle resistance	260°C reflow	Cycle	20
Peel strength	Cu plating	kN/m	0.60

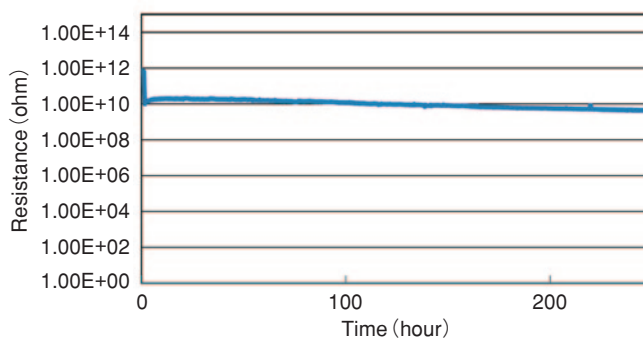


Figure 3 HAST resistance of PV-F008

## 5 Future Business Development

- Expansion of sales and application of developed product.
- Development of photosensitive insulation material for the next generation.