Comparison between Strain Gauges of F-backing and Strain Gauges of S-backing

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1. Comparison of strain gauge (SG) structures between the strain gauges of the F-backing and the strain gauges of the S-backing

Diagram of SG structure of the F-backing layer

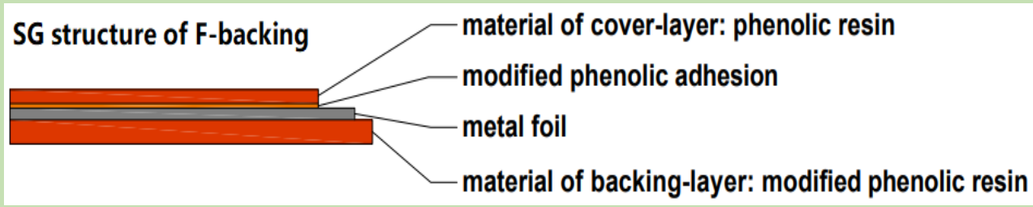
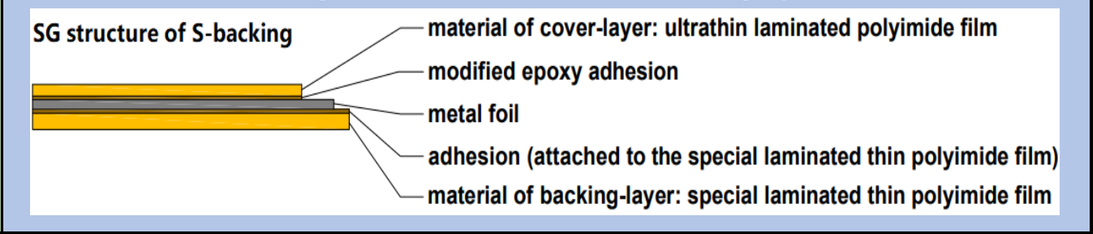


Diagram of SG structure of the S-backing layer

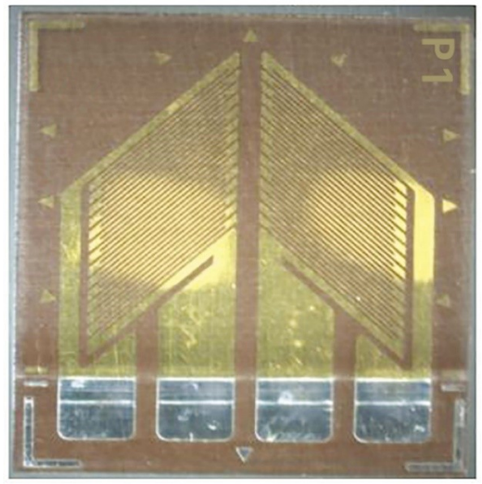
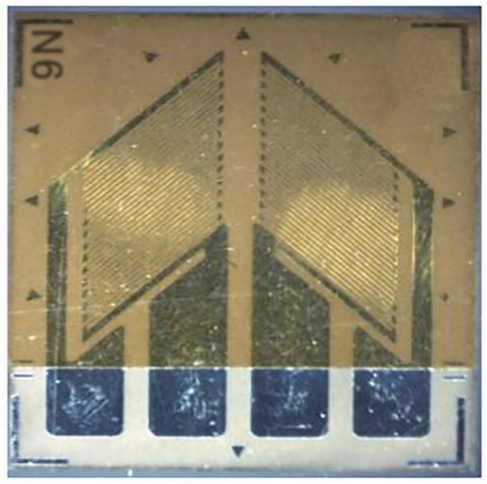


2. Legend of the colors to color the background of all the cells of this table in order to compare the S-backing to the F-backing

white background	Comparison between the technical terms.	blue background	The specifications are same for the F- and S-backing.
orange background	The specifications in these cells are better for the S-backing than those of the F-backing.	grey background	The specifications cannot be compared to evaluate the F- and S-backing by saying "better" or "worse".

3. Comparison of material characteristics and specifications between the strain gauges of the F-backing and the strain gauges of the S-backing

Category	Parameters	Specifications for the F-backing	Specifications for the S-backing
Comparison of Material Characteristics	material of the backing layer of strain gauges	modefied phenolic resin	special laminated polyimide with adhesion
	encapsulation material	phenolic resin	laminated polyimide
	thickness of the backing layer (μm)	50±10	26±2
	thickness of the encapsulation layer (μm)	16±3	13±1
	thickness of strain gauges over all production lots (μm)	73±13	55±5
	warpage of the backing layer (mm)	1~2	⩽0.7
	hygrothermal stability (i.e., the rate of resistance change due to both temperature and humidity) at 25 °C (ppm)	62	28
	hygrothermal stability (i.e., the rate of resistance change due to both temperature and humidity) at 50 °C (ppm)	64	29
	moisture absorption by the backing layer at 25 °C	3.0%	0.6%
	moisture absorption by the backing layer at 50 °C	3.5%	0.7%
	linear thermal expansion coefficient of the backing layer (10^-6/℃)	~66	~16
	shrinkage of the backing layer at 150 °C	0.5%	0.03%
	elastic modulus of the backing layer (Mpa)	2.45x10^3	3.09x10^3
	tensile strength of the backing layer (GMPa)	3	2.5
	compressive strength of the backing layer (Mpa)	~256	~231
	color of the backing layer	dark brown, refer to the photo below	yellow, refer to the photo below

Comparison of Specifications	creep dispersion	1.38	1.23
	insulation resistance of strain gauges (MΩ/100Vdc)	10^5	10^6
	resistance change of strain gauges before and after bonded to substrate (Ω)	0.5~1.5	0.2~0.5
	working temperature range of strain gauges (℃)	-30~+80	-30~+100
	gauge factor of strain gauges	1.80~2.20	1.80~2.20
	maxmium working strain of strain gauges (με)	5,000	5,000
	strain limit of strain gauges (με)	20,000	20,000
	fatigue life of strain gauges	10^7 load cycle @1000με	10^7 load cycle @1000με
	bonding strength to the substrate on which strain gauges are bonded (kN/m)	>0.5	≥0.5
	temperatures to solder leads or wires onto strain gauges	270~280°C for the free SG without bonding	265~275°C for the free SG without bonding
		300~310°C for the SG bonded onto substrate	290~300°C for the SG bonded onto substrate
comparison of two real strain gauges	Ordering Code of strain gauges	ECF-350-3HA-C-(11)-P1-SP	ECS-350-3HA-C-(11)-N6-C
	photos of the strain gauge		
	appearance of the backing layer observed under microscope=	The surface is smooth and flat. Small adhesive particles can be seen.	The surface is smooth, flat and bright.
	flexibility of the backing layer tested by pressing the gauge with a tweezer=	harder	more flexible.
	apperance of the backing layer of the strain gauge=	dark brown	yellow
	resistance ratio of two sensing grids measured in twomeasurements (Ω)=	350.55/350.44 in one measurement	350.26/350.26 in one measurement
		350.65/350.57 in another measurement	350.28/350.18 in another measurement
	difference in resistance between the two measured sensing-grids (Ω)=	0.095	0.050
	difference between average resistance R and nominal resistance R0 (Ω)=	0.553	0.245
Conclusions of Comparison	1. The thickness of the strain gauges of the S-backing is thinner and the thickness uniformity is evener, compared to that of the strain gauges of the F-backing. 2. The moisture absorption rate is lower for the strain gauges of the S-backing, compared to that of the strain gauges of the F-backing. 3. The resistance change of the strain gauge of the S-backing is less than that of the strain gauge of the F-backing before and after being bonded on the substrate. 4. Compared to the strain gauge of the F-backing, the strain gauge of the S-backing features more stable creep, smaller zero-return and more consistent performance, which enables the strain gauge of the S-backing more suitable for manufacturing of the load cells of C3 and even higher accuracies. 5. The operating temperature range of the strain gauges of the S-backing is wider than that of the strain gauge of the F-backing. 6. The solder-pads of the strain gauges of the S-backing can be copper-plated, while the solder-pads of the strain gauges of the F-backing cannot. As a result, it is no longer difficult to solder leads or wires onto karma strain gauges if the strain gauges are made of the S-backing.		