New Products

Resin Coated Metal Sheets " FCOAT-HA"

1. INTRODUCTION

1.1 Background

Copper or copper alloy such as phosphor bronze have superior electrical conductivity and ductility. Iron or iron alloy such as stainless steel have excellent rigidity and corrosion resistance. Beginning with electrical/electronic components, these materials are used in wide range of fields. Recently, electrical devices like mobile phone and notebook computer are becoming more integrated and smaller in size. Parts used for these devices are also required to have similar changes.

An example is a shield case for mobile phone. In the past, creating some space like an air layer could secure insulation between shield case and conductive components, in order to avoid circuit shunt. However, due to downsizing and high integration, it became impossible to have such air space. So, insulation has to be provided by other means. For this mitigation, an insulation layer is created to avoid circuit shunt among components. This mitigation is in more and more cases to downsize components.

1.2 Resin Coated Metal Sheets "FCOAT"

In order to meet the above mentioned needs, Furukawa Electric provides a compound material called resin coated metal sheets "FCOAT" shown in Figure 1. Resin varnish like polyamide-imide (PAI) resin is coated onto the surface of metal materials like phosphor bronze and stainless steel, then, it is thermally hardened to create an insulation layer of approximately 10 μm in thickness.[1)]

1.3 Background of FCOAT-HA Development

Due to recent components downsizing, there has been times where more severe processing conditions are required at press work. In case where the severe processing conditions were applied to a conventional FCOAT, issues like burr, dulling and resin peeling from metals might occur. To resolve these issues and to meet customer's requests, FCOAT, which can endure recent severe processing conditions by its inherent improved adhesion, was developed. This is what "FCOAT-HA" is about, introduced for this opportunity.

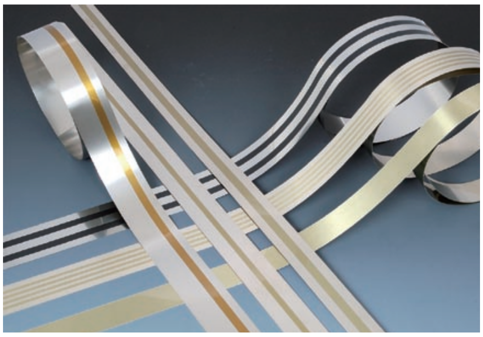

Figure 1 **Resin coated metal sheets "FCOAT".**

2. QUANTIFICATION OF ADHESION STRENGTH BETWEEN METAL AND RESIN BY SAICAS METHOD

2.1 Quantification Method of Adhesion Strength Between Metal and Resin

An adhesion evaluation of a conventional adhesive tape is quantified by a peel test. However, it was difficult to evaluate FCOAT by a peel test because its film is way too thin. So, it was necessary to devise other method to quantify adhesion strength between the metal and the resin of FCOAT. As the development of FCOAT-HA was progressing, a surface interracial cutting analysis system (SAICAS)[2)] was executed to carry on the evaluation.

2.2 SAICAS Method

An overview of the measurement using SAICAS is described as following. At first, a cutting blade cuts the coated film at an angle. When the cutting blade reaches nearby base material, a peeling of the material and the coating occurs. This part is called "microgap" and loading Fv detected by load cell decreases rapidly. When the microgap appears, the cutting blade's cut operation proceeds only in a parallel direction. The average load F_H after the parallel movement indicates the adhesion strength.

Figure 2 shows the coated film cutting operation by SAICAS. Figure 3 indicates an example of the adhesion strength measurement results. This is an example of the adhesion strength measurement of the metal and the resin, on a conventional FCOAT.

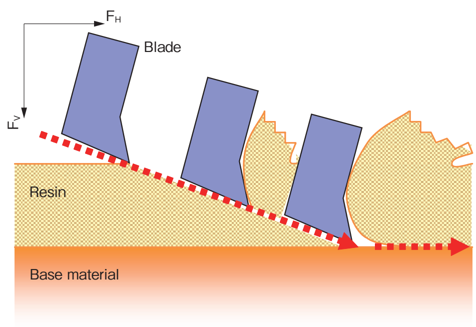

Figure 2 Schematic diagram of adhesion strength measurement using SAICAS.

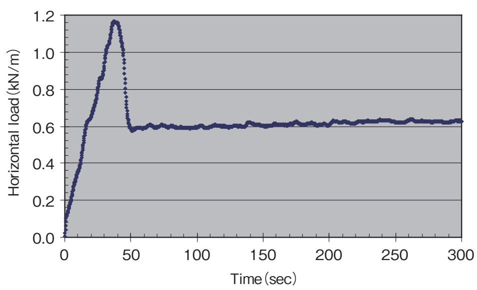

Figure 3 Example of measurement result using SAICAS. (The adhesion strength is about 0.6 kN/m.)

3. COMPARISON BETWEEN FCOAT AND FCOAT-HA

3.1 Adhesion Strength

Figure 4 shows a comparison of the adhesion strength measurement by SAICAS. Stainless steel (AISI301) was used as a base material. Conventional FCOAT's adhesion strength of the metal and the resin is approximately 0.6 kN/m. On the other hand, newly developed FCOAT-HA indicates a value two times higher, approximately 1.4 kN/m. Adhesion was drastically improved, which leads to an expectation that it can endure more severe press work than before.

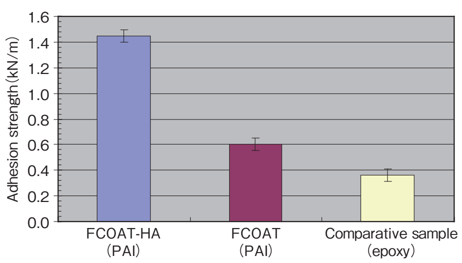

Figure 4 Comparison of adhesion strength between metal and resin.

3.2 Cross-Section Observation

The cross-section was observed in order to compare the peeling strength of resin when the material coated with FCOAT was punched by press work. Result is shown in Figure 5.

After punching press, the conventional FCOAT indicated 10 μm of resin peeling. On the other hand, the newly developed FCOAT-HA showed no peeling due to the strong adhesion strength. Also, according to figure 5, FCOAT-HA does not only show any peeling, but it is conceivable that dulling and burr are hard to occur. From above reasons, it is believed that FCOAT-HA brings many advantages into press work technology which leads to downsizing, more complexity, and reduction of maintenance frequency of metallic mold.

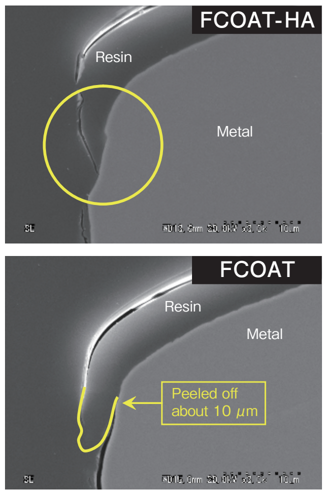

Figure 5 Cross-section observation of metal and resin after punching press.

4 IN CONCLUSION

In our FCOAT-HA development, we focused on and improved the adhesion strength of the metal and the resin. Our objective was to have no peeling of the metal and the resin even under severe press work. As a result, the adhesion strength of the metal and the resin reached values approximately 2 times higher. Also, it became possible to inhibit dulling and burr. It is expected that FCOAT-HA will be utilized as new component material.

Finally, comparative findings are shown in Table 1.

REFERENCES

(1) FURUKAWA ELECTRIC CO., LTD., "Resin Coated Metal Sheets FCOAT" Furukawa Review. Vol.32 (2007)

(2) Y.Kijima, I.Nishiyama., "The features Evaluation System for Interface Boundaries of Different Materials," Journal of The Adhesion Society of Japan, vol. 41, 234-241, (2007)

Table 1 Comparative findings.

			FCOAT-HA	FCOAT	Comparative product
Type of resin			polyamide-imide	polyamide-imide	epoxy
Adhesion strength (SAICAS)			approx. 1.4 kN/m	approx. 0.6 kN/m	approx. 0.4 kN/m
Cross cut test (1 mm×1 mm)	As		○	○	○
	Reflow simulation (260°C, 2 min.)		○	○	○
	PCT (121°C, 2 atm, 100% RH, 96 h)		○	○	△ (flake-like appearance)
	Heat cycle (–55°C×30 min/125°C×30 min, 200 cycles)		○	○	○
(Press punchability / Press bendability / Visual appearance no trace of crack or streak)	Peeling width on punching (dulling) side		almost 0 μm	almost 10 μm	almost 30 μm
	Peeling width on die (blurr) side		almost 0 μm	almost 10 μm	almost 10 μm
	Inner bendhing (Resin is inside)	0.025 R	×	×	×
		0.050 R	△	△	×
		0.075 R	○	○	△
		0.100 R	○	○	△
	Outer bending (Resin is outside)	0.025 R	○	○	△
		0.050 R	○	○	△
		0.075 R	○	○	○
		0.100 R	○	○	○
Abrasion resistance (3 mm steel sphere probe, weight 300 g, velocity 60 mm/min. distance 5 mm)			> 500 times	> 500 times	approx. 200 times
Surface roughness Ra			approx. 0.1 μm	approx. 0.1 μm	approx. 0.1 μm
Insulating resistance (surface resistance)			~ 10^8 MΩ	~ 10^8 MΩ	~ 10^4 MΩ

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