» New Products

Palladium Plated Strip for Micromotor Brush

1. INTRODUCTION

Micromotors are used in many applications such as sound equipment, consumer electronics, mobile phones, cameras and automobiles, and continuous demands for mechanical parts that have a variety of driving force is expected. Silver-palladium alloy (AgPd) clad strip is well known as the brush material. Though, there is an issue with the contact resistance and with the abrasion resistance induced by the surface contamination generated during the manufacturing process. In addition, the use of precious metals is large and it is recognized that the alloy is not suitable for cost reduction.
Therefore, the Company has developed a palladium (Pd) plating strip for the micromotor brush. The development is shown below.

2. FEATURES

Since the micromotor is considered for use in a variety of environments for a long period of time, then a low and stable contact resistance is desired for its contact resistance. After the environmental test, shown in Table 1, are conducted on a Pd plating strip of Pd thickness 1 μm and AgPd clad strip of AgPd thickness 10 μm, the contact resistance was measured. The result is shown in Figure 1. The Pd plating strip hardly changed the contact resistance during the environmental test, and an excellent stability (corrosion resistance) was maintained.

Table 1 Condition of environmental test.

Item	Test condition
Sulfide test	H_2S: 3 ppm, Temp.: 40℃ , Relative humidity: 80%, 24 hr
Moisture resistance test	Temp.: 105℃ , Relative humidity: 100%, Atmospheric pressure: 1.22 × 10^5 Pa, 16 hr
Air heating test	Temp.: 155℃ , 16 hr

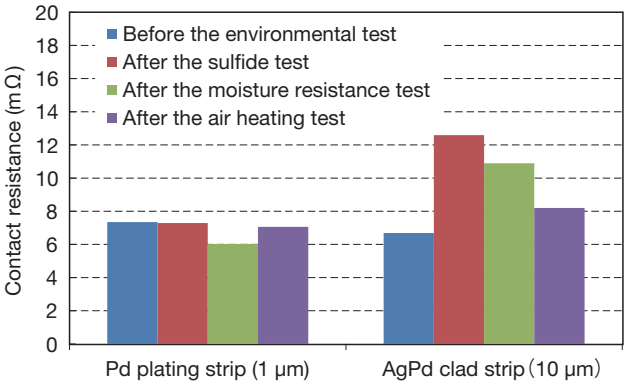

Figure 1 Contact resistance before and after the environmental test.

Table 2 shows the surface hardness, the dynamic coefficient of friction and the motor life time test results for the Pd plating strip and the AgPd clad strip. Both the surface hardness and the dynamic friction coefficient without current flow of the Pd plating strip and the AgPd clad strip are almost the same. AgPd clad strip has a tendency of an increase of the dynamic friction coefficient with the current flow. Based on the motor life time test using an actual prototype, our development Pd plating strip showed earlier down time than the one of the AgPd clad strip. But, in terms of the life time per coating thickness per 1 μm, the Pd plating strip has the advantage. Since the stable contact pressure to the commutator is required for the micromotor brush, the Company is recommending the use of a nickel silver (C7701) base metal, which has an excellent stress relaxation property. As shown in Table 2, the stress relaxation rate of the nickel silver is lower than that of the phosphor bronze (C5210), and is even equivalent in comparison with a spinodal alloy. Thus, the Pd plating strip is suitable for use for a long period of time.

Table 2 Properties of Pd plating and AgPd clad materials.

Item	Evaluation condition		Pd plating strip (Thickness: 1 μm)	AgPd clad strip (Thickness: 10 μm)
Surface hardness (Hk)	Knoop hardness, Test force 9.8 mN		408	401
Dynamic friction coefficient	Without current flow	Contact pressure49.0 mN, 10 mm Reciprocated, Max.value at 200 of Reciprocating.	0.4	0.4
	With current flow (100 mA)		0.7	0.9
Motor life time (Down time)	Brush pressure: 2 gf, 0.2 A, 2000 rpm, Commutator: Ag5 μm		4,000 hr	10,000 hr
			4,000 hr/μm	1,000 hr/μm

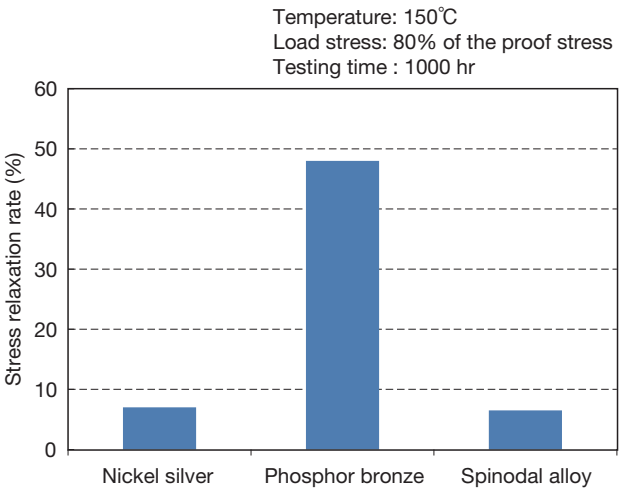

Figure 2 Stress relaxation properties of Cu alloys.

Table 3 Product specification.

Item		Manufacturing range
Base metal		C7701R, C5210R, etc.
Strip thickness		0.03 ～ 0.2 mm
Width		8 ～ 50 mm
Underplating		Matte Ni 0.1 ～ 2.0 μm
Pd stripe plating	Plating thickness	0.1 ～ 2.0 μm
	Stripe width	0.5 ～ 30 mm
	Stripe number	1 or 2

Figure 3 shows the surface condition of the Pd plating strip and of the AgPd clad strip (the base metal for both strips is the nickel silver.) Cracks observed on the surface of AgPd clad strip increases the wearing at the time of sliding and make easy to induce local corrosion in the environmental test, then cause an increase in the contact resistance. (Refer to Figure 1.) On the other hand, the Pd plating strip has no crack and maintains the high surface smoothness, and has an excellent motor life with a thin coating thickness. AgPd clad strip is believed to have the cracks created on the surface in manufacturing due to the repeating of the rolling and the annealing processes. We have achieved a Pd plating strip having a smooth surface condition without crack, through adjustments in the manufacturing process and the manufacturing conditions.

3. CONCLUSION

Pd plating strip for the micromotor brush that has been developed in the Company, has a lower contact resistance and is more stable than the existing AgPd clad strip, also has the same or a longer motor life time. The product specification of the Pd plating strip is shown in Table 3. Our Pd plating strip is capable of meeting the optimal configurations according to customer required specification, and ensures equal or higher performance as compared to the conventional clad strip. In addition, with a product design that takes advantages of the plating production process, we have been receiving good review from our customers for a product that can contribute to cost reduction.

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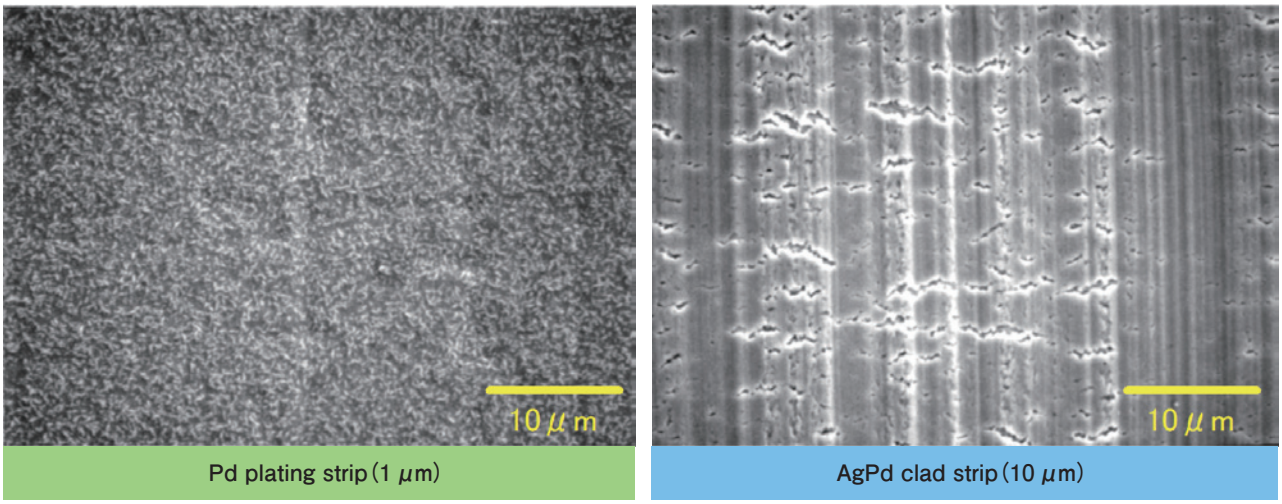

Figure 3 SEM images of Pd plating strip and AgPd clad strip.