Ranafoil™-E (Surface roughened aluminium foil)

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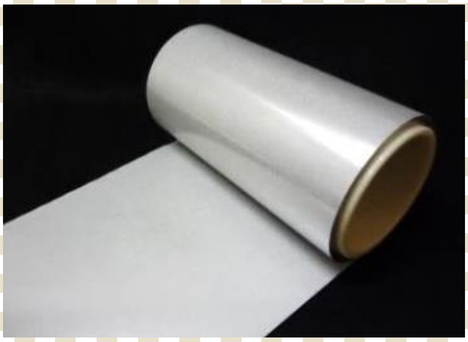

[1. Introduction]

Aluminium foils have excellent properties and can be used in a wide range of fields when they are combined with different types of materials and used as composite materials. In the energy field, aluminium foils can be used as a current collector for lithium-ion secondary batteries and electric double-layer capacitors because they are light weight and conduct electricity well. In the food, pharmaceuticals, and chemical product fields, applications of aluminium foils range widely because they are impervious to liquids and gases. For example, they can be used as a packaging material in combination with films.
Composite materials as mentioned above can be manufactured by putting aluminium foils through laminating and coating processes. One of the properties required in this case is good adhesion to different types of materials. This adhesion property can be obtained by chemically and physically bonding an interface between an adhesive and an adherend; it is often required to improve peel strength of an aluminium foil interface because the properties of a final product are greatly affected.
This technical report introduces Ranafoil™-E that helps improve peel strength by bonding a physical interface.

[2. Surface form of Ranafoil™-E]

Ranafoil™-E is the foil made by chemically treating the surface of aluminium foil with an etching solution to dissolve and roughen the surface. The foil helps improve peel strength by the anchor effect produced by the surface asperities.
Fig. 1 shows a SEM photo of the surface of Ranafoil™-E. It has dissolved portions (light areas) and difficult-to-dissolve portions (dark areas). Fig. 2 shows an enlarged photo of the surface of a dissolved portion and a photo of a cross section of the surface. Angular asperities are formed on the foil surface. This surface form is controlled by adjusting the amount dissolved based on purity of the aluminium foil, temperature of the etching solution, and treatment time. The amount dissolved and surface form vary depending on the composition of aluminium foil even if the foil is treated under the same etching conditions (Fig. 3).

Dissolved portion (light area)
Difficult-to-dissolve portion (dark area)

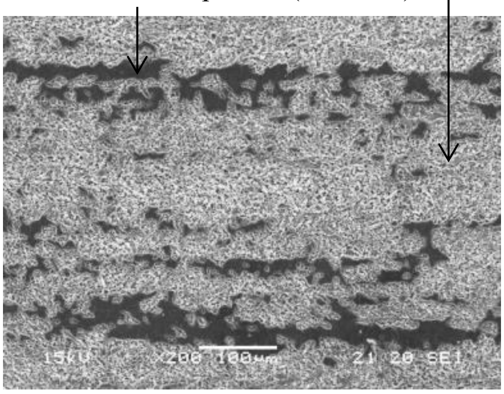

Fig. 1 SEM photo of the surface

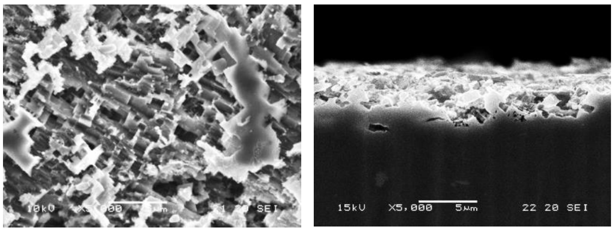

Fig. 2 SEM photos of the surface and cross section (enlarged dissolved portion)

<1N30 material> <8021 material>

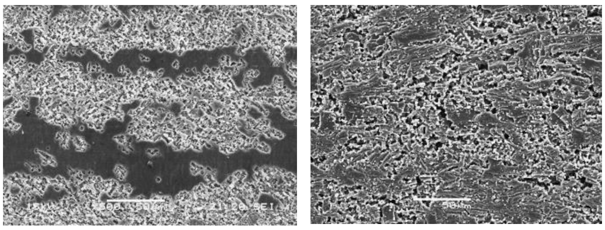

Fig. 3 Surface form varying depending on the composition

[3. Improvement in peel strength]

For comparison of peel strength, a total of three types of samples including untreated aluminium foil (hereinafter referred to as "untreated foil") and two samples of Ranafoil™-E with different dissolved amounts were used to evaluate the physical property. The aluminium foil used was 80 µm in thickness and a 1N30 (purity) material. Fig. 4 shows the results from comparison of surface roughness Rz between the foil samples and peel strength between the structure bodies made by laminating pieces of each foil. Peel strength was measured with a drum jig in the 90-degree peel test in accordance with JIS K6854-1. Surface roughness Rz was measured with a stylus surface roughness tester in accordance with JIS B0601:1982.

Based on the results shown in Fig. 4, peel strength and surface roughness Rz of Ranafoil™-E is higher than those of untreated foil. The larger the dissolved amount is, the higher the peel strength and surface roughness Rz of Ranafoil™-E are. Peel strength of the sample with a larger dissolved amount is higher than that of the untreated foil by as much as 25%.

Fig. 5 indicates SEM photos of cross sections that show the interfaces between the adhesive layers and each foil. The surface of the untreated foil is flat, whereas those of Ranafoil™-E have asperities. It can be seen that the larger the dissolved amount is, the more uneven the surface and the larger the uneven area are and the adhesive runs into the asperities.

From the above, we can conclude that the formation of surface asperities contributes to an increase in area of contact with an adhesive, resulting in improved peel strength.

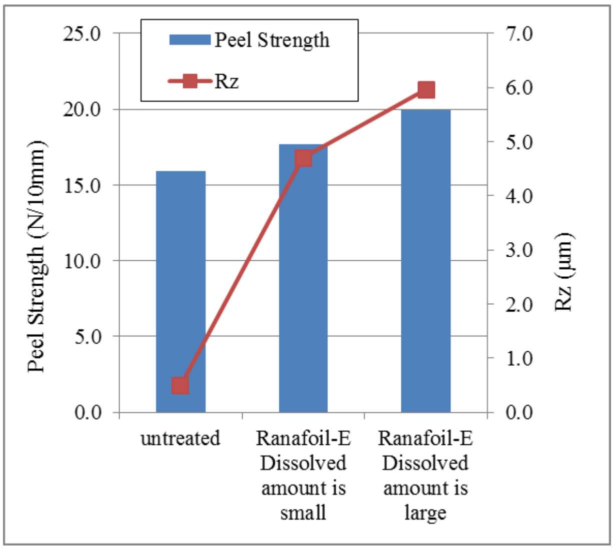

Fig. 4 Comparison of adhesive strength and surface roughness Rz

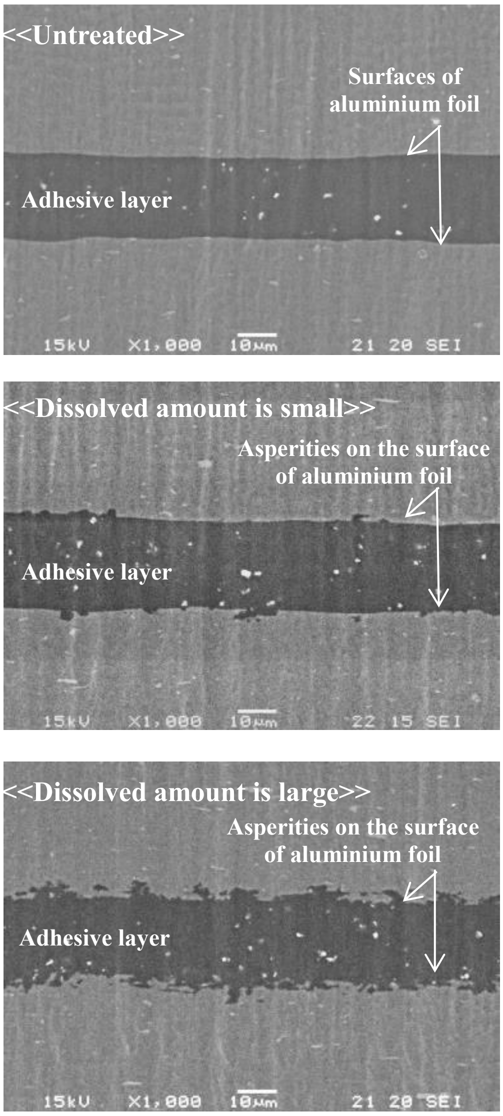

Fig. 5 SEM photos of cross sections of interfaces between adhesive and aluminium foil

[4. Conclusion]

This technical report explains how peel strength is improved by the anchor effect produced by asperities on the surface of Ranafoil™-E by showing an example of foil laminated with an adhesive. This shows that Ranafoil™-E can be used in a wide range of fields where good adhesion is required in the applications including packaging materials for foods, pharmaceuticals, and chemical products, current collectors for batteries and capacitors, electronic device components such as circuit boards, and industrial and construction materials.

We aim to extend the range of applications of Ranafoil™-E because its surface form can be customized to intended use.