

*Regular Paper***Formation of Electroless Plating Film on Smooth Surface of Syndiotactic Polystyrene Resin****Takehiro IWAMOTO<sup>1,2\*</sup>, Tatsuki HIRANO<sup>2</sup> and Mitsuhiro WATANABE<sup>2</sup>**<sup>1</sup>*Idemitsu Kosan Co., Ltd., 1-1, Anesakikaigan, Ichihara-City, Chiba, 299-0193, Japan*<sup>2</sup>*Kanto Gakuin University, Materials & Surface Engineering Research Institute, 1162-2, Ogikubo, Odawara-City, Kanagawa, 250-0042, Japan*

Received Aug. 24, 2022; accepted Oct. 4, 2022

**Abstract**

Syndiotactic Polystyrene (SPS) has excellent electrical properties. So it has been strongly expected for SPS to apply for high frequency circuits. We conducted to form the metallizing layer on smooth surface of the SPS substrate by using the UV treatment and the electroless plating and examine the effects of crystallinity and containing SEBS for peel strength. We also investigated the mechanism of the peel strength using FTIR analysis, XPS analysis, TEM observation and EDS analysis. It was confirmed that the UV treatment and the plating process including the electroless Cu-Ni plating in the specific conditions on the smooth surface of the SPS substrate that had low crystallinity and contained SEBS formed the conductivity layer which indicated the practical peel strength. The fracture mode during the peeling was observed the shift from an interfacial to a cohesive failure according to increasing SEBS content. The mixed metal-resin layer at the interface was observed, which would be considered to strengthen the peel strength. We evaluated to utilize the electroless Cu plating process for the SPS substrate as well.

*Keywords: Syndiotactic Polystyrene, SEBS, UV treatment, Electroless plating, Crystallinity, Peel strength*

**1. Introduction**

High speed and large-capacity data transmission is strongly required due to rapidly increasing electronic devices for telecommunications, sensors, wireless LAN systems and so on, and the high frequency bands in GHz region is widely used recently. In such fields, the substrate materials are required excellent electrical properties, such as low dielectric constants and low dielectric dissipation factors ( $\tan\delta$ ). Syndiotactic Polystyrene (SPS) is one of the candidate material for the high-frequency applications, exhibiting low dielectric constant and low dissipation factor over wide frequency range [1]. SPS has not only excellent electrical properties but also high heat-resisting properties and low water absorption. In general, it is difficult to achieve the practical adhesion between the substrate that consists of non-polar groups and the metallized conductivity layer made of copper. In that case, it is essential to roughen the surface of the substrate in order to obtain the efficient adhesion due to the anchor effect. Chemical etching is generally used for the step using

chromic acid. However, the use of chromic acid has a high environmental impact, and surface roughening causes to increase the high-frequency transmission loss. Therefore, with respect to the technology to form metallized a conductivity layer, UV treatment is a potential process to modify the substrate surface to improve adhesion strength without the chemical etching [2-4]. On the other hand, little has been done to examine the metallization for the SPS substrates using UV treatment. In this study, we conducted to assess the UV treatment and the electroless plating on the smooth surface of the SPS substrates, and examine the effects of the resin compositions and the crystalline conditions for the peel strength.

**2. Experimental method****2.1 Sample preparation**

Syndiotactic Polystyrene (SPS) with a weight average molecular weight of 200,000 and poly (styrene-block-ethylenebutylene-block-styren) triblock copolymer (SEBS) were

\*Corresponding author: takehiro.iwamoto.7440@idemitsu.com