

*Regular Paper***Influence of Seed Layer on LCP Substrate for High-speed Transmission Characteristics****Tomoyuki ISHII^{1,2,3,*}, Joo-Hyong NOH^{1,2}, Hideo HONMA^{1,2}, Osamu TAKAI^{1,2} and Mitsuhiro WATANABE^{1,2}**¹ Graduate School of Engineering, Kanto Gakuin University, 1162-2 Ogikubo, Odawara-shi, Kanagawa 250-0042, Japan² Materials and Surface Engineering Research Institute, Kanto Gakuin University, 1162-2 Ogikubo, Odawara-shi, Kanagawa 250-0042, Japan³ Toppan Printing CO., LTD., 1-5-1 Taitou, Taitou-ku, Tokyo 110-8560, Japan

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Abstract

Signal circuits between processor units and connected components in a computing system, require high signal transmission speed. In order to reduce the transmission loss of the substrate for semiconductor package, it is necessary to control the manufacturing process. Considering the skin effect in high frequency region, the characteristics of the seed layer formed on the LCP (Liquid Crystal Polymer) resin may affect the high-speed transmission characteristics. However, it has not been verified how the changes of such seed layer states affect the quality of high-speed signal transmission. In this paper, we prepared LCP substrates containing signal copper circuits with different thickness and conductivity of copper seed layers formed by electroless plating and sputtering. Furthermore, the S-parameters (S₂₁) of the transmission lines on these substrates were measured. The S-parameter results suggested that the volume resistivity of the seed layer and the structure of the interface between the seed layer and the conducting layer affect the transmission characteristics.

Keywords: LCP, Seed Layer, Electroless Plating, Sputtering, Transmission Characteristic

1. Introduction

In order to achieve an advanced information society, the ability and speed of signal processing inside and between electronic devices is constantly increasing [1, 2], and the demands is growing year by year. Also for printed wiring boards and semiconductor packages, the process design of transmission line adapted for high speed transmission is required [3-5]. It is necessary to match the characteristic impedance matching, select the materials of insulators and conductors, and optimize the transmission structure and so on. High-speed transmission must reduce the transmission loss of transmission line, especially the improvement of dielectric loss and conductor loss is necessary [6-8].

For a semiconductor package substrate, an epoxy-based resin is usually used as the insulating material for the build-up

layer, but for high-speed transmission substrates, it is required to improve the dielectric properties of the epoxy-based resin to reduce the dielectric loss [9, 10]. However, there is a limit to the improvement of the dielectric properties of the epoxy-based resin in reducing dielectric loss, so it may be difficult to cope with further high-speed transmission. Therefore, it is desirable to change the resin and use an insulating material with better dielectric properties as substitute resin material [11]. As an insulating resin suitable for high-speed transmission, a Liquid Crystal Polymer (LCP) resin having excellent dielectric properties has attracted attention. The LCP resin has been used for flexible printed circuit boards and module boards for antenna applications. In recent years, its applications have been further expanded [12-16].

As for reducing the conductor loss, it is necessary to improve

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