Consideration on Grounded Coplanar Waveguide for RF-MEMS Integration

Futoshi Kuroki [(1)] and Kengo Nakajima*[(1)], Masanori Eguchi[(2)], and Takeshi Yamakawa [(2)]
(1) National Institute of Technology, Kure College, Kure, 7378506, Japan, kuroki@kure-nct.ac.jp
(2) Fuzzy Logic Systems Institute, Kita-kyushu, 8080135, Japan, eguchi@flsi.or.jp

Semiconductor technologies are usually applied into RF switches. The use of the RF-MEMS technology is another candidate for the purpose of creating a low loss switch. With this in mind, the mounting structure of the MEMS switch on the coplanar waveguide was investigated at 60 GHz as a basic research of the MEMS for phased array antenna applications. Figure 1 shows the cross-sectional view of the MEMS-mounted coplanar waveguide consisting of a glass substrate with a thickness of 0.18 mm and a relative permittivity of 6.7, being implemented to the microstrip line etched on the Duroid substrate with a relative permittivity of 2.2. First the optimum thickness of the Duroid substrate was calculated at 60 GHz changing the thickness. Assuming ε_{eff} and ε'_{eff} to be the effective permittivities of the coplanar waveguide and the parallel plate mode transmitting between the ground planes of the coplanar waveguide and the microstrip line, respectively, ε_{eff} normalized by ε'_{eff}, that is $\varepsilon_{eff}/\varepsilon'_{eff}$, was calculated changing the thickness of the Duroid substrate. The calculated results are shown in Fig.2. When $\varepsilon_{eff}/\varepsilon'_{eff}$ equals 1 or is bigger than 1, in other words, when the phase velocity of the guided wave of the coplanar waveguide is slower than that of the parallel plate mode, unnecessary leakage waves don't occur into the Duroid substrate. From this consideration, the thickness of the Duroid substrate was determined to be 0.508 mm. Next, the transmission characteristics of the coplanar waveguide mounting the MEMS switch were calculated. A low loss transmission loss less than 2 dB and a high isolation larger than 30 dB were obtained at 60 GHz.

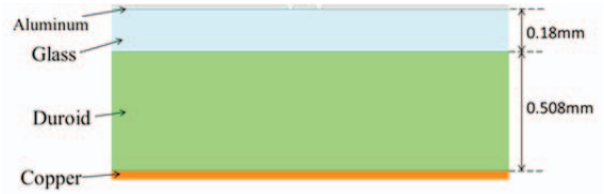

Fig. 1. Cross sectional view of coplanar waveguide on microstrip line.

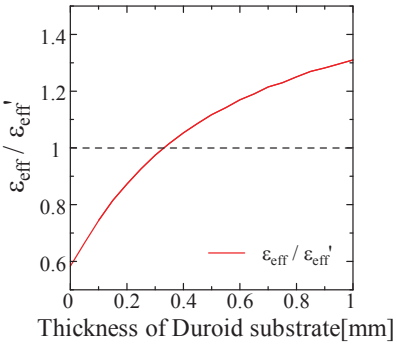

Fig. 2. Calculated $\varepsilon_{eff}/\varepsilon_{eff}'$ versus thickness of Duroid substrate.