MULTISLOTLINE FERROELECTRIC TRANSMISSION LINE: RESULTS OF FULL-WAVE ANALYSIS AND EXPERIMENTAL STUDY OF THE PHASE SHIFTER

I.G. Mironenko, A.A. Ivanov, S.S. Karmanenko, N.N. Isakov, T. Inushima, and M.V. Pavlovskaya

1Electrotechnikal University, 197376 St.Petersburg, Russia
2Tokai University, 1117 Kitakaname, Hiratsuka 259-1292, Japan

The novel type of microwave transmission line based on the layered structure including ferroelectric film (FEF) was proposed. Full-wave analysis of this line was performed and a comparison of transmission characteristics with free slot and coplanar lines was conducted. The original CAD model based on full-wave approach was developed for simulation of waveguide and resonance microwave elements. The propagation constant versus of a (ε×h) product (h - ferroelectric film thickness and ε its dielectric permittivity) was simulated at the frequency region of 25-45 GHz. The FEFs of about 1 µm thick were deposited on dielectric substrate (sapphire or alumina), then the film surface was covered by copper layer (about 3 µm) and it was patterned as multislot transmission line using photolithographic procedure. High quality FEF had the tunability coefficient $K = 1.5-2.0$ at electric field about 3–5 V/µm. Thus, the slots should be rather narrow in order to minimize bias voltage applied to the electrodes. However, in this case the microwave losses stipulated by finite conductivity of the electrodes become higher. The multislot microwave transmission line is a way to overcome these inconsistencies. In such line the narrow electrodes located between edges of a "broad" slot execute simultaneously: electrodynamic function ensuring the drain of electromagnetic energy along the slotline, and a function of DC electrodes forming on the slot width a required electric field for ε control in the limits of narrow gaps. Design of the phase shifter based on multislot FEF line is presented and the results of phase shifter examination are discussed.