KOLLOQUIUM

Institut für Elektrotechnik, Elektronik und Informationstechnik

Tunable Passives based on Nonlinear Dielectrics in Microwave Technology

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Agile materials and technologies based on nonlinear dielectrics like ferroelectrics (FE) or liquid crystals (LCs) offer a line of tunable passive microwave components such as varactors, phase shifters, filters and tunable matching networks, suitable in phased-array antennas, e.g. for automotive radar sensors, in reconfigurable (frequency-agile) radios, e.g. in mobile communication systems with multiband operation or RF-ID systems. The trend towards these commercial microwave applications involves a demand for cheaply integrated, compact devices with both, high tunability and low insertion loss. Therefore, distinct research interests have been focused on agile materials for tunable passives as promising alternatives to active semiconductor devices or MEMS varactors.

Starting with some applications and physical fundamentals, the focus of this presentation will be on our research of tunable passive microwave components based on (1) ferroelectric thick- and thin films and (2) liquid-crystals. For our basic investigations we develop model-based microwave characterization methods from 1 MHz up to 65 GHz, to gain a physical understanding and to get the material characteristics as input data for innovative design concepts of tunable microwave passives. Next, the micro-technological realization and characterization of some prototype devices are presented in co-planar or microstrip-line technology.

One specific example will be an inverted-microstrip line phase shifter based on recently developed, novel highlyanisotropic microwave LCs. With these LCs, a figure-of-merit of above 110°/dB at 24 GHz has been achieved with comparatively low control voltages less than 30 V. At the same frequency, this exceeds by far the figure-ofmerit of 30 to 50°/dB of FE-coplanar waveguide phase shifters, however, with much lower tuning speed. This substantial progress opens up totally new low-cost LC applications beyond optics.