LOW-LOSS MICROWAVE DIELECTRICS FOR DIFFERENT FREQUENCY REGIONS

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Depending on the operating frequency range of modern communication systems various microwave elements are required for effective operation of radio equipment. In this work potential ways of developing microwave dielectric materials for different frequency regions will be discussed based on the reference data and experimental results obtained by the author.

The first group of the materials includes solid solutions of the barium lanthanide titanates $Ba_{6-x}Ln_{8+2x/3}Ti_{18}O_{54}$ (Ln = La – Gd) (BLTss) with the structure of tetragonal tungstene bronze. These materials are intended for the decimeter wavelength band. Here the main emphasis will be paid to the solid-state reaction mechanism for the formation of BLTss as well as the abnormal behavior of their dielectric parameters. Deriving from the obtained data the competing action of both harmonic and inharmonic contributions to the phonons of the BLT crystal lattice will be discussed with respect to its effect on the temperature behavior of the permittivity and dielectric loss in the BLTss.

The second group of the materials includes both A-site and B-site deficient perovskites $Ba(M_{1/3}^{2+}Nb_{2/3})O_3$ (M – Co, Zn, Mg) with the enhanced microwave quality factor (*Q*). These materials are intended for the centimeter and millimeter wavelength bands. We have found that a slight deviation from the compositional stoichiometry promotes both sintering and cation ordering processes in studied materials. These phenomena will be discussed in terms of their effect on the dielectric properties of studied materials in the centimeter and millimeter wavelength bands. A significant “extrinsic” contribution to the microwave dielectric loss has been found in Co and Mg -containing perovskites. Possible structural factors responsible for the variation of the quality factor in studied systems will be shown and discussed. As a consequence the highest magnitudes of the *Qxf* product have been obtained in the Co-deficient $Ba(Co_{1/3}Nb_{2/3})O_3$ (*Qxf* = 90 000 GHz), and in the Ba-deficient both $Ba(Zn_{1/3}Nb_{2/3})O_3$ (*Qxf* = 90 000 GHz) and $Ba(Mg_{1/3}Nb_{2/3})O_3$ (*Qxf* = 150 000 – 200 000 GH) after sintering in relatively “soft” regimes.

As the consequence of the presented findings, several examples of the possible applications of studied materials in the microwave engineering will be also presented.