Abstracts

Use of whispering-gallery modes for complex permittivity determinations of ultra-low-loss dielectric materials

J. Krupka, K. Derzakowski, A. Abramowicz, M.E. Tobar and R.G. Geyer. "Use of whispering-gallery modes for complex permittivity determinations of ultra-low-loss dielectric materials." 1999 Transactions on Microwave Theory and Techniques 47.6 (Jun. 1999, Part I [T-MTT]): 752-759.

Whispering-gallery modes are used for very accurate permittivity, dielectric loss, and temperature coefficient of permittivity measurements for both isotropic and uniaxially anisotropic dielectric materials. The relationship between resonant frequencies, dimensions of the resonant structure, and permittivity of the sample under test is calculated with a radial mode-matching technique. The relative accuracy of these computations is better then 10/sup -4/. The influence of conductor losses on dielectric loss tangent determination is treated for both whispering-gallery-mode and TE/sub 01/spl delta//-mode dielectric-resonator techniques. Two permittivity tensor components of sapphire and their temperature dependence were measured from 4.2 to 300 K. The total uncertainty in permittivity when use is made of whispering-gallery modes was estimated to be less than 0.05%. The uncertainty was limited principally by uncertainty in sample dimensions. Experimental and calculated resonant frequencies of several whispering-gallery modes differed by no more than 0.01%. The dielectric loss tangent of sapphire parallel and perpendicular to its anisotropy axis was calculated to be less than 10/sup -9/ at 4.2 K. The permittivity and dielectric loss tangent of a commercially available low-loss high-permittivity ceramic material has also been measured at S- and C-band frequencies using a large number of whispering-gallery modes.

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