MEASUREMENT OF DIELECTRIC LOSSES IN CVD DIAMONDS IN MILLIMETER WAVE BAND AT LOW TEMPERATURES

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The problem of output windows in gyrotrons and of analogous input windows in fusion reactor for realization of initial heating of plasma is the most critical in Project of ITER. Therefore necessity of high-quality radiotransparent materials are great [1]. Recently detailed investigation of properties CVD diamonds characterized by low dielectric and thermal losses, especially with increasing of frequency, is required. One of most precise techniques of measurement of such materials is the method of disk dielectric resonator (DDR) with whispering gallery modes (WGM) [2].

We designed the experimental cryogenic complex for measurement of properties of low loss dielectrics in the millimeter wave band (30-150 GHz) and at temperatures T=0.6-300 K [3]. Complex includes cryogenic and electrodynamical modules. Refrigerator is manufactured as a "top-loading refrigerator", enabling one to change a sample during the experiment without increasing the temperature. Electrodynamical module provides the location and the effective excitation of the DDR. The DDR is manufactured with the optical precision from the material under test. Spectrums and field characteristics of DDR were registered by using of an automatic measuring test-bench. High-Q $EH_{mn\ddot{a}}$ modes with n=0 and were used as working modes.

Model experiments for measurement loss tangent tan$d$ for several promising technological materials (sapphire, semiconductors, CVD-diamonds) are carried out. We investigated two CVD diamond samples, produced by General Physics Institute of Russian Academy of Sciences (1) (d=20.6 mm, h=0.34 mm) and by DeBeers Company (2) (d=18.02 mm, h=1.85 mm) in a frequency band 60-115 GHz and at temperatures 4.2-300 K. With decreasing of temperature tan$d$ decrease from $1.7\cdot10^{-4}$ (300 K) to $1.3\cdot10^{-4}$ (4.2 K) for sample 1 and from $9\cdot10^{-5}$ (300 K) to $5\cdot10^{-5}$ (4.2 K) for sample 2 at frequencies about 112 GHz.

Thus the values of loss tangents of diamonds which perspective for use as output and input windows of high frequency powerful devices are measured. The experimental results are summarized in the graphic and tabulated forms.

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