Dielectric properties of the nano composites on the base of crosslinked poly(ε-caprolactone)

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Till now the dielectric parameters of nano composites based on crosslinked poly(ε caprolactone) (cPCL) remain poorly investigated in enough wide frequency range.

In the present work a research of the complex dielectric permittivity of cPCL composites with nano particles of multiwall carbon nano tubes (MWNT), nano Fe_3O_4 and Fe_3O_4 absorbed MWNT is carried out at wide ranges of frequencies $f = 10^{-1}–2\times10^{6}$ Hz and in the millimeter wave range (f = 80-100 GHz). On different frequencies the different equipment was used, and different measurement techniques of parameters of materials were applied.

At low frequencies up to 10 kHz we used laboratory equipment, at frequencies from 10 kHz to 2 MHz device BDS-40 (Novocontrol) was used.

In the millimeter range Scalar Network Analyzer working in the frequency band 78–118 GHz was applied. The complex parameters of a material, such as real n and imaginary k parts of the refraction index, real $\varepsilon' = n^2 - k^2$ and imaginary $\varepsilon'' = 2nk$ parts of dielectric permittivity in the millimeter range were calculated from the measured quantities of transmission and reflection coefficients of plane- parallel samples.

Sample cPCL changes ε' from 13 at frequency 10^{-1} Hz to 7 at frequency 10 Hz and does not changes up to 2 MHz. Nano composites have much more ε', from 48 to 19 at frequency 10^{-1} to 13-8 more than 10 Hz. $\varepsilon''$of cPCL changes from 40 at frequency 10^{-1} Hz to 0.03, has minimum at 200 kHz, and then increases up to 0.08 at 2 MHz. Nano composites have ε'' = 115-40 at frequency 10^{-1} Hz and then decreases up to $'$ approximately 0.1 at frequency 2 MHz.

In the frequency band 90–100 GHz sample of cPCL has ε' 2.9 and ε''= 0.03. Nano composites have ε' = 3.0- 3.4 and ε'' = 0.045 -0.27.

[1] B.M. Garin , I.A. Chmutin, V.V. Meriakri, B.A. Murmuzhev, E.E. Chigryai, M.P. Parkhomenko, V.S. Solosin, S.V. von Gratowsky, N.A. Fedoseev, Chen Wang, Jingsong Zhu, International Kharkov Symposium on Physics and Engineering of Microwave, Millimeter and Submillimeter Waves, Proceedings, paper W 10, Kharkov, Ukraine, June 31-26, 2010, IEEE Catalog Number: CFP10780-CDR, ISBN: 978-1-4244-7898-9.