Influence of neutron flux on frequency dependence of dielectrically properties of nano SiO_2

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Recently, nano SiO_2 and its different combinations have been in the focus point of the world researchers and its some properties have been studied theoretically and practically [1,2]. Also, nano SiO_2 is widely applied in electronics and technology, especially in spacecraft electronics and nuclear technology [1,2]. As the free relaxation range of defects and electron excitation in nano size states of substances and materials is in the order of particle size, the difference between volume and surface features in these systems is removed. Therefore, nano materials are of great importance as an effective system for all fields characterized by formation of the factors of energy transportation, defect and electron excitation and transmission to the surface level. As an example to such systems it can be sited nuclear fuel materials, the systems detecting high energy radiation, radiation catalysts and processes related with other radiation material sciences. Recently for these features, nano substances and materials are widely applied as an actual and prospective system for nuclear and radiation technologies.

As a research object it has been taken SiO_2 with $160m^2/g$ specific surface area, 20nm particle size and 99,5% purity [3-7]. Nano SiO_2 has been irradiated at full power mode (250 kW) by neutron flux with $2x10^{13}$ $cm^{-2}s^{-1}$ flux density in central channel (channel A1) at TRIGA Mark II light water pool type research reactor in "Reactor Centre" of Jozef Stefan Institute (JSI) in the city of Ljubljana of Slovenia. It is important to note that the JSI TRIGA reactor has been thoroughly characterized and the computational model used for computational characterization has been thoroughly verified and validated against several experiments [8-12]. While working at full power mode, the neutron flux has the following composition parts: $5.107x10^{12}$ $cm^{-2}s^{-1}$ (1±0.0008, E_n < 625eV) for thermal neutrons, for epithermal neutrons – as $6.502x10^{12}$ $cm^{-2}s^{-1}$ (1±0.0008, E_n ~ 625eV ÷ 0.1MeV), for fast neutrons - $7.585x10^{12}$ $cm^{-2}s^{-1}$ (1±0.0007, E_n > 0.1 MeV) and finally for all the neutrons in central channel flux density is as $1.920x10^{13}$ $cm^{-2}s^{-1}$ (1±0.0005).

In the result of the conducted researches it has been revealed that under neutron flux influence the dielectric constant of nano SiO_2 increases in general tendency. At 100K value of temperature the real part of dielectric constant increases with increase of neutron flux influence period regardless of frequency. It has been revealed that the real and imaginary parts of dielectric constant depend on frequency inversely proportionally at relatively high temperatures (200K, 300K and 400K). With neutron flux influence the increase in dielectric constant is more severe at low frequencies. From complex dependences of real and imaginary parts of dielectric constant of nano SiO_2 particles it has been revealed that the clusters formed at 100K temperature induce the device to show dielectric loss as negative value. At other temperatures (200K, 300K and 400K) from the cases similar to Cole-Cole diagrams it has been revealed that the value of relaxation period is compatible with the polarization of nano particles.

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