EFFECT OF GAMMA IRRADIATION ON THE AC-DIELECTRIC PROPERTIES OF GASE SINGLE CRYSTALS

S.N. MUSTAFAEVA, A.A. ISMAILOV
Institute of Physics, National Academy of Sciences of Azerbaijan, Baku
E-mail: solmust@gmail.com

GaSe crystals are layered wide-gap semiconductors with a rather high dc resistivity at 300 K. The purpose of this work was to investigate the ac-dielectric properties of GaSe single crystals and influence of gamma irradiation on dielectric coefficients of studied crystals.

The single-crystal GaSe samples for dielectric measurements had the form of planar capacitors normal to the C axis of the crystal, with silver-paster electrodes. The thickness of the GaSe samples was 200μm. The dielectric properties of the GaSe single crystals were studied by a resonance technique using a TESLA BM 560 Q-meter. Loss tangent (tanδ), real (ε) and imaginary (ε′′) parts of complex dielectric permittivity of GaSe have been studied in the frequency range f = $5 \cdot 10^4$ to $3.5 \cdot 10^7$ Hz. All the measurements were performed at 300 K in alternate electric fields

corresponding to Ohmic current-voltage behavior. Co^{60} serves as the source of irradiation with energy of γ-quantum equal to 1.3 MeV. The dielectric coefficients of non-irradiated and γ-irradiated GaSe crystals were measured under the same conditions. As a result of the measurements conducted, it has been revealed that in the case of the high frequencies ($f>2\cdot10^5$ Hz) of the alternate electric field applied to the crystal the dielectric permittivity of the specimen showed no significant variation due to γ-irradiation, whereas in the case of the frequencies $f<2\cdot10^5$ Hz, the ε value decreased by two times as a result of irradiation. For example prior to γ-irradiation the ε value at $f=5\cdot10^4$ Hz amounts to 8.3, whereas after irradiation (with dose 50kR) this value amounts to 4.1. At $f=5\cdot10^4$ Hz the imaginary (ε′′) part of complex dielectric permittivity of GaSe almost doubled as a result of γ-irradiation.

Increasing the frequency from $5\cdot10^4$ to $3.5\cdot10^7$ Hz reduces the ε of GaSe by more than a factor of 5 and that of γ-irradiated GaSe by a factor of 2.7. The observed monotonic reduction in the dielectric permittivity of non-irradiated and γ-irradiated GaSe single crystals with increasing frequency attests to the relaxation nature of the dispersion. The frequency dependences of the loss tangent for the GaSe prior and after γ-irradiation have maxima, which also point to relaxation losses.

Thus the γ-irradiation leads to the modification of dispersion curves ε(f), ε′′(f) and tanδ(f) of GaSe single crystals. The operation by the dielectric coefficients of the studied GaSe single crystals due to γ-irradiation gives perspective for the use of these objects as active materials for creating of various transducers and gamma detectors.