# Development of $Ga_{1-x}B_xSe$ - Based Photodetectors for High-Frequency Optical Signal Conversion

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Recent advancements in radio communication networks and the extensive use of fiber-optic technologies have escalated the demand for efficient photodetectors capable of handling high-frequency optical signals. A primary challenge in this domain is the effective reception and conversion of high-frequency optical signals into electrical signals [1]. To address this issue, this study proposes the development of photodetectors based on gallium-boron-selenium ($Ga_{1-x}B_xSe$) compounds. These photodetectors exhibit photosensitivity in the near-infrared and visible spectra [2], with an anticipated photosignal relaxation time on the order of nanoseconds. Such properties suggest their capability to handle optical signals with frequencies up to 10 THz, converting them effectively into electrical signals. Figure 1 presents the photocurrent kinetics of a $Ga_{0.95}B_{0.05}Se$ crystal under conditions of high optical excitation. The analysis of the photocurrent kinetics reveals that the relaxation time for quasi-equilibrium charge carriers in the $Ga_{0.95}B_{0.05}Se$ crystal is approximately 12 ns. The rapid relaxation is attributed to a recombination portential with a localization depth of 0.9 eV observed within the crystal. This characteristic makes $Ga_{0.95}B_{0.05}Se$ a promising candidate for developing photodetectors capable of operating at gigahertz frequencies.

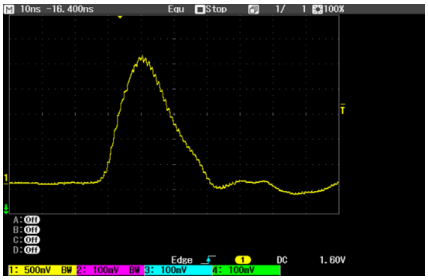

Fig. 1. Photocurrent kinetics of $Ga_{0.95}B_{0.05}Se$ crystal

Unlike alternative materials used in photodetector fabrication, $Ga_{1-x}B_xSe$ demonstrates a notable resistance to signal distortions during the reception and conversion processes. This material's intrinsic properties extend the high-frequency operational range of the detector into the terahertz spectrum. Consequently, the implementation of $Ga_{1-x}B_xSe$ - based photodetectors has the potential to enhance the speed of information transmission across extensive distances, thereby benefiting modern information technology.

1. 1. Ellis, Andrew D., Jian Zhao, and David Cotter. "Approaching the non-linear Shannon limit." Journal of lightwave technology 28.4 (2009): 423-433
2. 2. S. Das, C. Ghosh, O. G. Voevodina, Y. M. Andreev, and S. Y. Sarkisov, Appl. Phys. B: Lasers Opt. 82, 43 (2006).