SovietRxiv

Soviet-era science, translated into English

Reports of the Academy of Sciences of the USSR

Corresponding Member of the Academy of Sciences of the USSR N. G. BASOV, L. M. LISITSYN, B. D. OSIPOV

1963

SovietRxiv

View the original and related papers at https://sovietrxiv.org/items/ru-196301.64741

Source: Math-Net.Ru and CyberLeninka. Machine translation. Verify with the original.

SovietRxiv

Figure 1

Figure 1: Figure 1

Abstract

Full Text

Reports of the Academy of Sciences of the USSR
1963. Volume 149, No. 3

PHYSICS

Corresponding Member of the Academy of Sciences of the USSR N. G. BASOV, L. M. LISITSYN, B. D. OSIPOV

APPLICATION OF AN OPTICAL QUANTUM GENERATOR FOR EXCITING RECOMBINATION LUMINESCENCE IN SEMICONDUCTORS

For the creation of quantum generators based on semiconductors, it is of interest to obtain high concentrations of nonequilibrium carriers ([1]). One of the methods for exciting nonequilibrium carriers is the optical method ([2]). In the present work, the recombination radiation of germanium, silicon, and gallium arsenide was studied at high excitation levels.

Fig. 1. Oscillograms of the pulse of recombination radiation **1** and of the pulse of exciting light **2**

As the source of optical excitation, a quantum generator on ruby with wavelength 6934 Å was chosen. The flux density of the exciting radiation in our case reached values up to 10^6 W/cm^2. Therefore, in order to avoid heating of the sample, a pulsed quantum generator was used, with a light-pulse duration of 200 μsec. The flux density of the exciting radiation could be regulated by changing the dimensions of the spot when focusing the beam of the quantum generator. Sharp focusing led to damage of the sample surface due to evaporation. In the measurements, a regime was used that did not cause damage to the sample.

The sample was made in the form of a Weierstrass sphere 8 mm in diameter. The material used was n-type germanium with a resistivity of 40 ohm · cm and a diffusion length of 1.5 mm. The sphere was polished; the end face was etched in boiling 30% hydrogen peroxide with an addition of alkali for 10 min.

Fig. 2. Spectrum of the recombination radiation of germanium at nitrogen and helium temperatures

SovietRxiv

Figure 2

Figure 2: Figure 2

For measurements at low temperatures, the sample was placed in a cryostat on a cold finger. To protect against stray light from the generator pumping lamp, a water filter was used.

The recombination radiation under study, in the form of separate pulses, was analyzed with an IKS-12 spectrometer. A lead sulfide photoresistor with a time constant of 100 μsec served as the detector. The signal was observed with a broadband amplifier and an OK-17M dual-beam oscilloscope. To monitor the operation of the quantum generator, an FEU-22 photomultiplier was used.

Oscillograms of the recombination-radiation pulse 1 and of the exciting-light pulse 2 are shown in Fig. 1.

The intensity of the recombination radiation at liquid-nitrogen temperature, compared with room temperature, increased by approximately 2 orders of magnitude. The intensity of the recombination radiation at liquid-helium temperature, compared with liquid-nitrogen temperature, increased by a factor of 2–3. The spectrum of the recombination radiation of germanium at nitrogen and helium temperatures is shown in Fig. 2. Similar results were obtained for silicon and gallium arsenide.

It is proposed in further work, for studying the kinetics of recombination processes, to use a quantum generator of short light pulses with a duration on the order of 10^{-7} sec.

Physical Institute named after P. N. Lebedev
Academy of Sciences of the USSR

Received
17 XII 1962

REFERENCES

1. N. G. Basov, O. N. Krokhin, Yu. M. Popov, *UFN*, **72**, issue 2 (1960).

2. J. R. Haynes, H. B. Briggs, *Phys. Rev.*, **86**, No. 4, 647 (1952).

Note: Figure translations are in progress. See original paper for figures.

Source: Math-Net.Ru and CyberLeninka. Machine translation. Verify with the original.