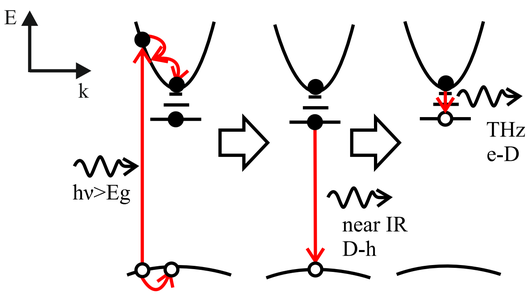
Integrated intensity of terahertz photoluminescence of doped GaAs epilayers

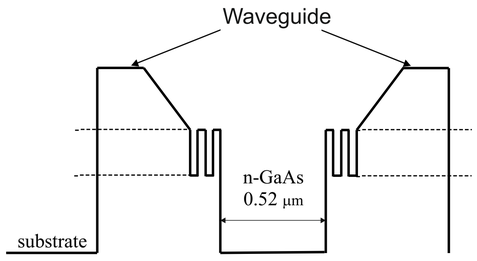
Kharin N. Yu.[1], Vinnichenko M. Ya.[1], Fedorov V. V.[1], Panevin V. Yu.[1], Firsov D. A.[1], Kropotov G. I.[2]
[1]Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia
[2]TYDEX, LLC, St. Petersburg, Russia

1. Introduction

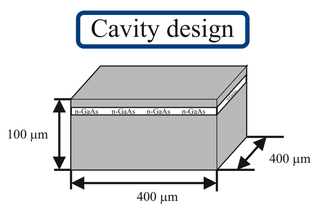
In a sample with n-GaAs epitaxial layer, nonequilibrium electrons in the conduction band and holes in the valence band are formed under the action of interband optical pumping. Their further thremalization and trapping to impurity levels can be accompanied by emission of THz radiation. Stimulated interband radiation depopulates the main donor (or acceptor) states and can increase the intensity of THz radiation

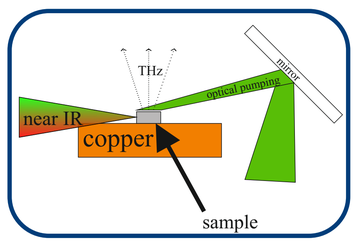


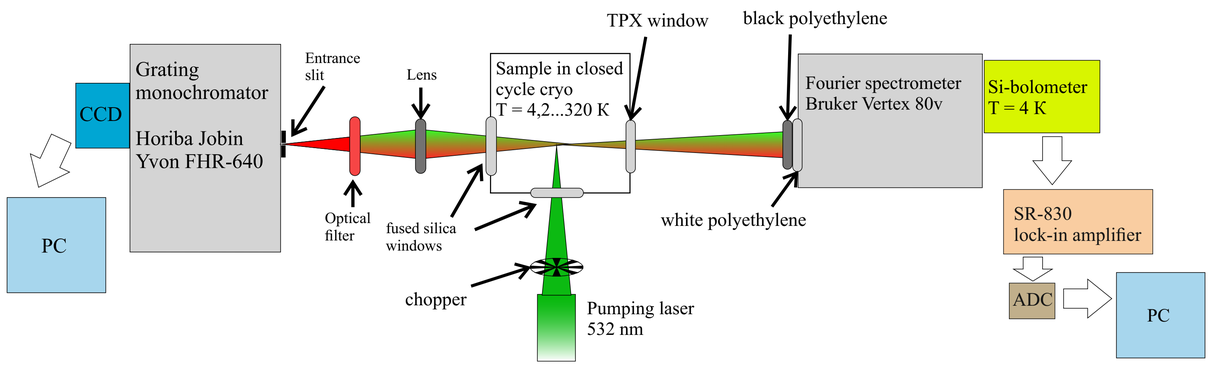
2. Sample and experimental setup



Cavity design

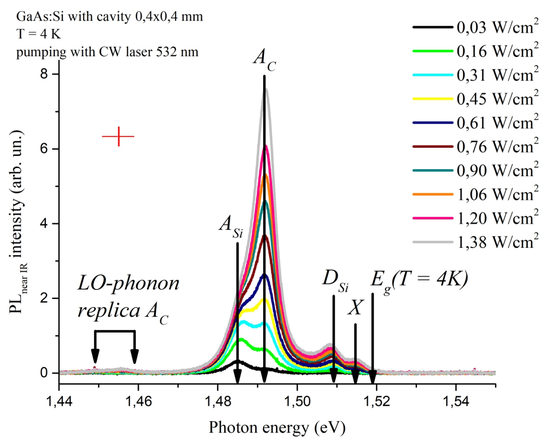




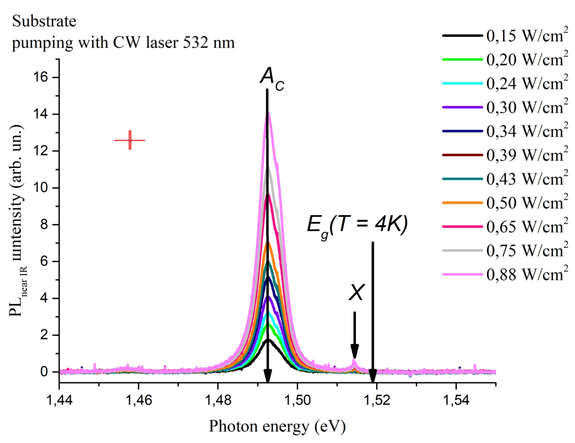


3. Results and discussion

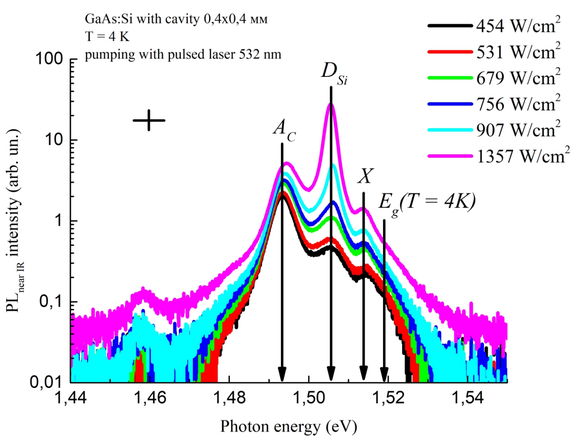
Photoluminescence (PL) spectra of the sample in the near infrared range with CW laser pumping

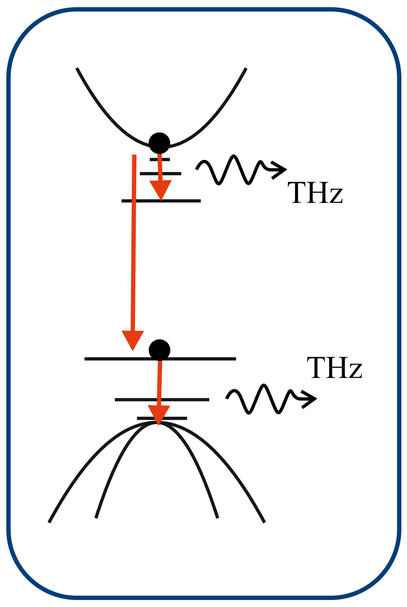


Photoluminescence spectra of the substrate in the near infrared range with CW laser pumping

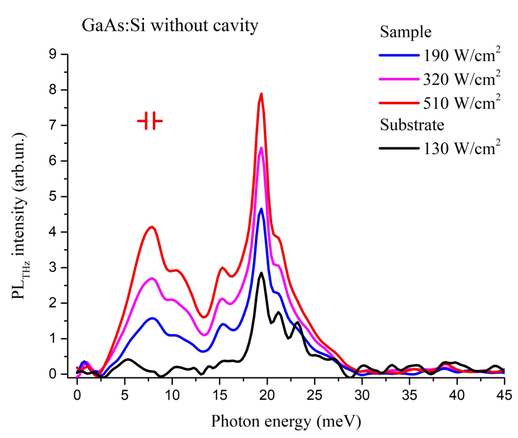


Photoluminescence spectra of the sample in the near infrared range with pumping by pulsed laser

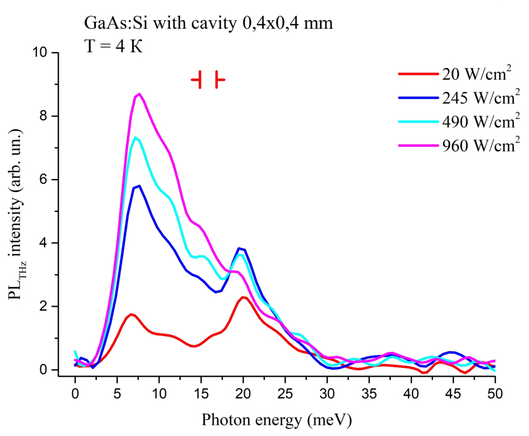




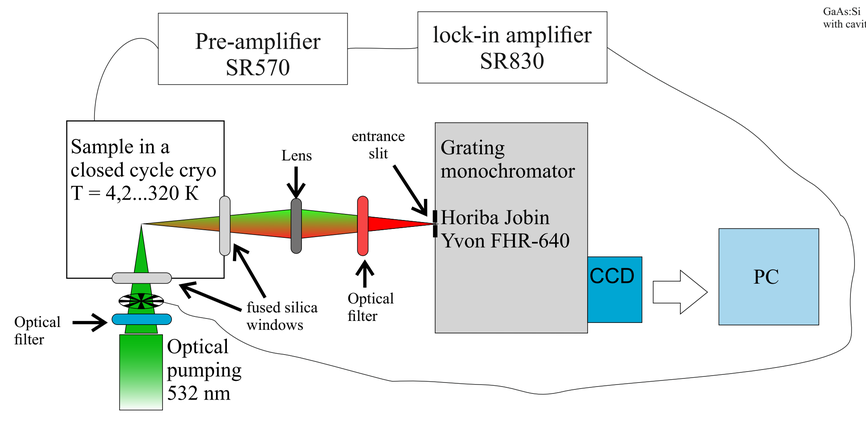
Photoluminescence spectra in the THz range of the substrate and sample without cavity

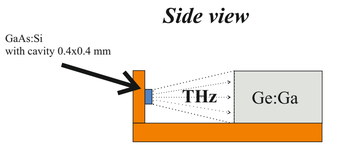


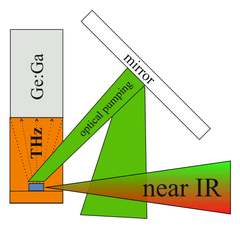
Photoluminescence spectra in the THz range of a sample with a cavity



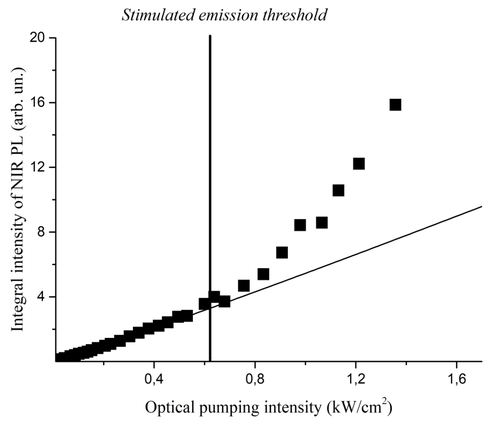
4. Integrated PL intensity



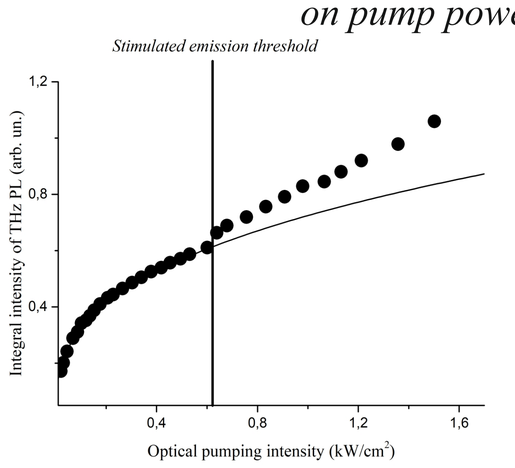




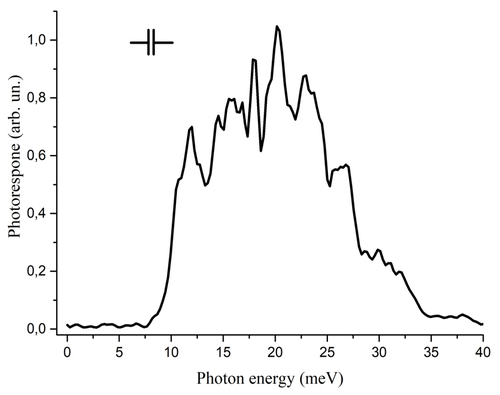
Dependence of the integral intensity of photoluminescence in the near infrared on the pump power



Dependence of integral intensity of terahertz photoluminescence on pump power



Ge:Ga detector sensitivity

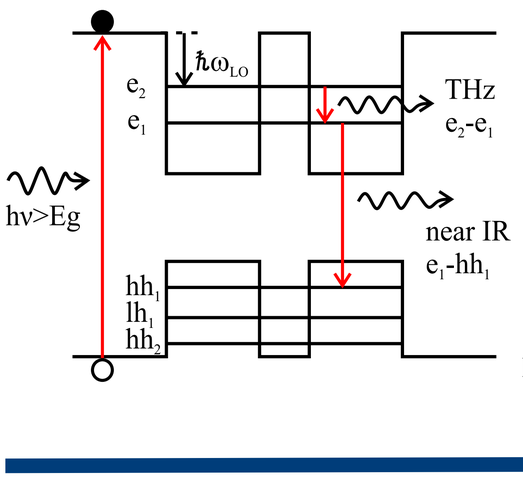


Outcome:

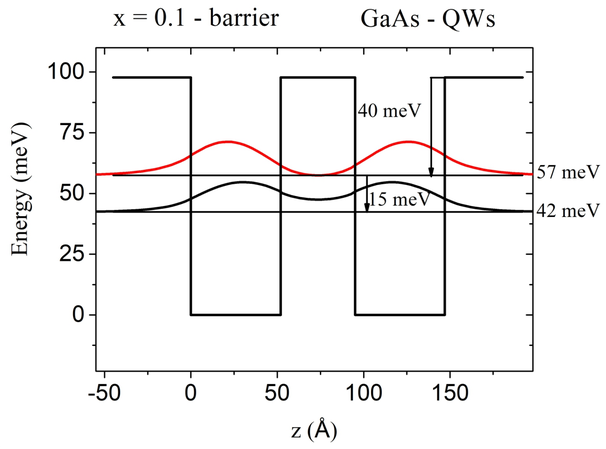
- *THz PL spectra are obtained*
- *Integral dependences THz PL were obtained*
- *The proposed mechanism of THz radiation intensity enhancement was confirmed*

5. Second sample

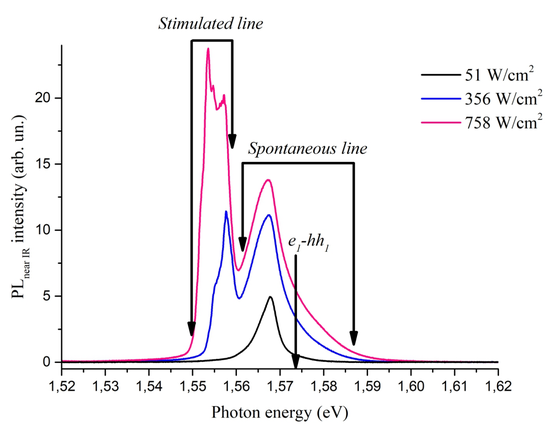
A scheme for similar studies, but in a structure with quantum wells



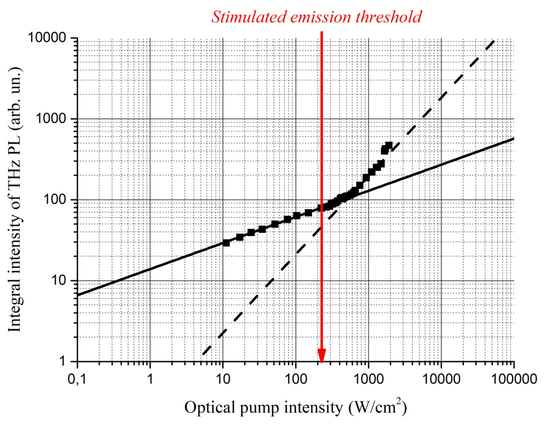
Conductivity band profile of the investigated structure with GaAs/AlxGa1-xAs QWs



Photoluminescence spectra in near infrared spectra of the sample with quantum wells



Dependence of integral intensity of THz photoluminescence on optical pumping power



6. Acknowledgment

This work was supported by the Russian Science Foundation (grant # 23-12-00036, https://rscf.ru/project/23-12-00036/)