High power NovoFEL: developments and new results

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***Abstract* — This talk present the parameters of NovoFEL THz source and users program.**

I. Introduction And Background

IN the Budker Institute of Nuclear Physics of the RAS Siberian Branch the creation of powerful FEL based on four-track energy recovery linac (ERL) with a maximum energy of 40 MeV is close to completion. The planned range of wavelength is between 240 and 5 μm, the expected radiation power varies from 1 kW in the long-wave range up to 10 kW in the short-wave range.

The first stage of Novosibirsk high power free electron laser (NovoFEL) was commissioned in 2003. The radiation spectral range is 110 – 240 μm at the first harmonic, 60 – 117 μm and 40 – 80 μm at the second and third harmonics correspondingly. The maximum average power is up to 0.5 kW for the first harmonic. The maximum peak power is 1 MW, pulse duration is 40-100 ps and repetition frequency 5.6 and 11.2 MHz. Relative spectral width is 0.25 – 1%. The radiation is completely spatial coherent, the degree of linear polarization is better than 99.6%.

The first lasing of the second stage NovoFEL was achieved in 2009. The radiation wavelength range now is 40-80 micron. Output power is about 0.5 kW.

Laser radiation is transmitted from NovoFEL through nitrogen-filled optical beamlines to the experimental hall. To provide ultrahigh vacuum in the FEL and accelerator-recuperator, their vacuum volume is separated from the beamlines with the diamond window.

Six user stations (the metrology station, photochemistry station, biological station, introscopy and spectroscopy station, molecular spectroscopy station, and gas-dynamic station) are now in use for experiments.

II. Results

The themes of works with using of NovoFEL THz radiation in 2011-2012:

1. Investigation into the interaction of THz radiation with new functional resonant metamaterials for devices controlling the polarization, phase, intensity and direction of propagation of radiation.
2. Study of the spectrum of electronic states in Si / CaF_2 BaF_2 / PbSnTe:In nanoheterostructures.
3. Investigation into the interaction of THz radiation with materials based on carbon nanotubes.
4. Exploration of composite silicon-polymer nanostructures.
5. Spectroscopy of attenuation total reflection (ATR).
6. Plasmon spectroscopy of surfaces and films.
7. Development of time-resolved superfast THz spectroscopy.
8. Development of the physical foundation of tomography, holography and metrology using a source of coherent monochromatic THz radiation.
9. Development of methods for flame diagnostics using the THz FEL.
10. Investigation of possibility of photoionization of atoms in strong electric fields of THz radiation.
11. Study of the impact of THz radiation on genetic material.
12. Exploration of the impact of THz radiation on stress-sensitive biological cell systems.
13. THz radiation influence of the katG and E.coli dps genes.
14. Study of the integrated proteomic response of E.coli exposed with terahertz radiation.

III. Conclusion

The Novosibirsk terahertz free electron laser is becoming a user facility. We invite those researches who want to perform interesting experiments with a high power monochromatic coherent tunable THz radiation to carry out them in Novosibirsk.

Acknowledgment

We thank the Ministry of Education and Science of the Russian Federation and RFBR for support.

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978-1-4673-1597-5/12/$31.00 ©2012 IEEE