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Super wide luminescence and super radiance of $Al_xGa_{1-x}N$ under optical and e-beam pumping

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It is desirable for the ultrafast communications, optical computer, etc., to create the lasing medium with as broad band as possible. To solve this task, the investigations of lasing and luminescence characteristics Si doped $Al_xGa_{1-x}N$ epitaxial films 0.5…1.2 μm thickness on the sapphire substrate were carried out. The following excitation methods were used: a) by an electron beam with the energy to 20 keV, pulse duration 10 …100 ns; b) second harmonics and summary frequency of copper vapor laser on wave length 255, 271 and 293 nm; c) fourth harmonic of Nd^{3+}:YAG laser with wave length 266 nm. In either case, the luminescence spectra are similar and they have an edge band with x-dependent wavelength from 365 nm to 310 nm and a broad band taking over the whole visible spectral range and near infrared one with broad band up to 500 THz. The main characteristics of superradiance in the broad band are presented. The spectral range depends from x and extends from 400 nm to 750 nm at x=0.5 and from 330 nm to 700 nm at x=1. The gain of active media also depends from x and is equal g=70cm^{-1} for weak signal (0.7%/μm) for x=0.5 and g=20cm^{-1} for x=0.74. The dependences of output power from active media length and pumping power demonstrate three features: a smooth growth at low pumping power or at small active length, then exponential growth and eventually comes to the saturation. The obtained resultants can be used for both the creation of waveguide lasers in a wide range and lasers with the femtosecond pulse duration.

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Generation of high power pulses with high repetition rate with subnanosecond pulse front for pumping different lasers

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The output characteristics of laser essentially depend on power supply pulse duration and its energy. This case is a very important switching characteristic of a device used for short and powerful pulse generation. The subnanosecond breakdown stage in the kivotron, novel switching device with counter-propagating electron beams based on the open discharge in helium, was experimentally studied. It was shown that the fast discharge stage arises when the discharge self-sustaining regime is ensured by the photoelectron emission from the cathodes due to resonant radiation emitted by fast helium atoms that have large Doppler shifts with respect to the line center. Since the excitation cross-section of a helium atom by another fast helium atom increases rapidly with the energy of the fast atom, the duration of the breakdown stage strongly depends on the working voltage in the range 2-10kV and weakly from 15 to 100 kV. The switching time less than 80ps was achieved when discharge circuit loaded to a resistance $R_L \geq 50\ \Omega$. Decrease of RL down to 10 Ω increases the switching time to about 100ps at 1.5-kA current with current density 120A/cm^2. A minimum switching time that can be achieved via kivotron design optimization is estimated to be about 35ps. A kivotron has to be used for pumping of different laser, including copper vapor laser, semiconductor lasers, etc. It was demonstrated that in this case it is possible to improve essential laser output characteristics.

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