TERAHERTZ RADIATION SOURCE FROM A STATIC ELECTRIC FIELD VIA A LASER-PRODUCED IONIZATION FRONT*

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Light sources in the terahertz spectral region are developing for various potential applications in the novel diagnostics such as testing of semiconductor materials, determining complex refractive index and electric conductivity. The photoconductive antenna based on transitional current modulation emits ultrashort pulse with broad spectrum. The power of THz emission source such as photoconductive antenna, however, is low in the order of nW level.

A plasma-based DC to AC radiation converter (DARC) can directly convert from periodic electric DC field to electromagnetic AC wave. When a laser-produced ionization front propagates through capacitor array that is biased to produce an electrostatic field, at each point and time ionization front crosses it generates a burst of current and consequently a half-cycle pulse of radiation. The energy of electrostatic field is directly converted into the emission pulse. The pulses from capacitor array have coherent pulse train. The radiation frequency of DARC depends on the laser-produced plasma density and geometry of the DARC structure[1]. The characteristics of THz source based on the DARC are capable of controlling the radiation frequency and emitting high output power with short pulse. In our experiments, the capacitor plates were placed at 4 mm intervals and alternately biased with 1 kV/mm. The temporal waveform of the THz emission was measured by use of an electro-optic (EO) sampling diagnostic. Two cycles wave with a period of 0.8 ps was observed. The Fourier transformed spectrum of the temporal signal THz waveform has a peak of 1.2 THz with a bandwidth of 0.7 THz (FWHM). According to the emission principle of the DARC, the relative frequency bandwidth of $\Delta\omega/\omega \approx 1/N$ is defined as the ratio of FWHM to the central frequency, together with the width of a spectrum. The bandwidth is evaluated to be $\Delta\omega/\omega \approx 0.6$. The use of a capacitor array can extend the excitation length to observed sufficient optical THz pulse train[2].

1. T. Higashiguchi *et al*., Appl. Phys. Lett. **90**, 2007, pp. 111503; and references therein.
2. T. Higashiguchi *et al*. (submitted to Appl. Phys. Lett.).

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