

STUDY OF THE EFFECT OF PULSE SHAPING IN TERAHERTZ GENERATION PROCESS FROM GAS PLASMA

by

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An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

DOCTOR OF PHILOSOPHY

Major Subject: Physics

The original of the complete thesis is on file
in the Rensselaer Polytechnic Institute Library

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Rensselaer Polytechnic Institute
Troy, New York
December, 2010

ABSTRACT

Terahertz (THz) wave has shown great potentials in technological applications such as explosive detection, chemical/biological sensing, imaging etc. However, use of many of these applications in real world is still limited by the availability of intense THz radiation source. The photo-ionized gas plasma has become a useful THz source because of its ability to generate intense THz field and broadband spectrum compared to other available THz sources. As a result, the discovery of gas plasma source expedited the advances in THz technology. However, the underlying physical mechanism of the generation process has not been fully understood yet.

THz wave generation from gas plasma source involving ionization of gas molecules is a nonlinear process and hence is highly sensitive to small changes in phase or temporal shape of the optical pulses. We used phase only pulse shaping technique to study the generation process. We demonstrated that by adding a periodic phase pattern to the optical pulses we can generate modulated THz spectrum, which can also be controlled by tuning the phase parameters. By controlling the phase parameters of the periodic phase we were able to generate tunable narrowband THz spectrum with a wider tunable range from 2.5-7.5THz. Tunable narrowband THz sources are suitable for the study of phenomena involving relatively narrow bandwidth and are desirable for some applications in spectroscopy, imaging, and coherent control. We also employed an adaptive control technique based on genetic algorithm to optimize the THz generation process by using the phase of the optical pulses as the parameter. The dependence of ionization process on the phase and temporal shape of the optical pulse provide us with an opportunity to increase the ionization of gas molecules and hence the generated THz field intensity. The intense THz pulses is desirable for standoff detection, imaging and also in the study of nonlinear effects of THz wave. We studied the effect of THz generation in presence of pre-pulse using two pulse sequence. By varying the temporal separation between two pulses we measured the changes in the THz generation process.