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Thomson Scattering Diagnostics of Plasmas for Industrial Applications

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We have been applying laser Thomson scattering (LTS) to various industrial plasmas in order to characterize those plasmas. In this paper, two examples are presented. One is atmospheric pulsed-filamentary discharges, and the other is VHF plasmas.
Atmospheric pulsed-filamentary discharges were produced to simulate dielectric barrier discharges (DBD). The discharge gas was Ne at 400 Torr. Fast rising discharges were created between a needle electrode and a hemispherical electrode with a gap of 0.5 mm. Applied voltage was about 3 kV and the pulse width of the current waveform was around 20 ns FWHM. Typical parameters observed at 20 ns after the start of the discharge were electron density of $5x10^{22}$ m^{-3} and electron temperature of 2 eV. Spatial distributions of electron density and temperature and their temporal evolutions were measured in detail, and the discharge processes were analyzed quantitatively based on those measurements.
VHF plasmas are adapted to deposition processesof microcrystalline silicon solar cells. In order to obtain high deposition rate, the VHF plasmas are produced at relatively high gas pressure up to 10 Torr. In order to know characteristics of such VHF plasmas, we are developing a LTS diagnostic system. We tried to detect LTS signals from a VHF plasma. The VHF power source with a frequency of 60 MHz was used and the power was 100 W. We established a plasma of electron density $5x10^{15}$ m^{-3} and electron temperature ~5 eV, which were evaluated by a Langmuir probe. The light source of LTS was the 2nd harmonics of the YAG laser (wavelength 532 nm, pulse width 10 ns, output 420 mJ/pulse, repetition 10 Hz). We have just succeeded to detect TS signals which are consistent with above density and temperature. Systematic LTS measurements are now in progress.

Keywords
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