Electric-Field-Induced Coherent Anti-Stokes Raman Scattering in Visible Region for Sensitive Measurements in Near-Atmospheric-Pressure Environments

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Electric field is one of the most important parameters for understanding/controlling plasma. While various methods are available for the field measurements in low-pressure environments, limited methods are readily available in high-pressure environments, such as near-atmospheric-pressure environments. Especially in the area without electrically-excited species, the currently available choices seem to be non-linear laser spectroscopies.

Here, I am presenting our recent development of electric-field-induced coherent anti-Stokes Raman scattering (E-CARS) in the visible region (E-CARSv) for sensitive electric-field measurements in high-pressure environments [1,2]. While this method is essentially same as E-CARS in the infrared region [3], the signal can be initiated in the visible region with infrared-laser and visible-laser irradiations. When the energy of the infrared laser is tuned to the Raman transition energy of the probe molecules (examples are shown in Table 1), the signal, which has an energy equal to the sum of the energies of two incident lasers, is generated in the presence of an electric field. So far, we have successfully demonstrated the E-CARSv generations from hydrogen [1] and nitrogen [2] molecules. The results indicated that this method can allow us to detect a week electric field of 0.5 V/mm in atmospheric-pressure hydrogen environment. Further details will be presented at the symposium.

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Table 1. Raman transition energies of several gaseous molecules.

Gas	Wavenumber (cm^{-1})
H_2	4155 [4]
N_2	2330 [5]
O_2	1556 [5]
CH_4	2916 [4]
CO_2	1388, 1286 [5]

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