【Grant-in-Aid for Scientific Research(S)】

Integrated Science and Innovative Science (New multidisciplinary fields)

Title of Project : Diagnosis of urban air quality by laser spectroscopy and the controlling strategy for oxidant formation

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Research Area : Environmental analysis

Keyword : Oxidant, laser spectroscopy, air quality, VOC, NOx

【Purpose and Background of the Research】

In spite of tremendous reduction of ozone precursor molecules (NOx and VOCs) in Tokyo compared with the situation in 20 years ago, oxidant is recognized to increase 1-2 % per year in recent years. In this project the cause of increasing trend of surface ozone by intensive field studies and process investigations. Seeking of un-known VOC which contributes for OH removal from the atmosphere will help to understand recent increasing trend of ozone. OH reactivity measurements of each source such as vehicular emission as well as atmosphere will be carried out.

Possibility of unknown VOCs which will be generated in the atmosphere due to photochemical reaction is also investigated by use of photochemical smog chamber at NIES Japan. The emission from single plant is also studied by OH reactivity measurement as well as VOC analysis by GC.

NOx chemical conversion process especially in night time is investigated by NO3 radical detection with laser induced fluorescence technique. Not only NO3 but also N2O5 is also measured to evaluate nitrate formation in night time from the heterogeneous process of N2O5.

Finally almost all the data obtained from this project will be gathered and model analysis will be carried out using C-MAQ chemical transport model. The most effective controlling strategy for ozone formation will be provided resulted from model output.

【Research Methods】

The following sub themes are set in order to seek missing sink of OH radicals and increase knowledge of NOx conversion process in the night as follows,

1. Intensive field studies using laser spectroscopy both at city center and sub-urban areas.
2. Development of instrument to measure OH reactivity by laser spectroscopy.
3. OH reactivity studies under photochemically controlled condition using smog chamber.
4. OH reactivity measurement of single plant emission.
5. OH reactivity study of vehicular emission using chassis dynamometer.
6. Up-take coefficient studies by processed SOA by radicals.
7. Reactivity measurement of NO3 with some important VOCs.
8. Oxidation capacity estimation of NO3 in vertical scale using tower in the field.
9. Model studies of air quality prediction.

1,2,4,7, and 7th themes are investigated in charge for the group of Tokyo Metropolitan University and the rests are studied by the Atmos. Group in National Institute for Environmental Studies.

【Expected Research Achievements and Scientific Significance】

To provide useful information about the strategy for improving air quality in megacity is the heart of this project. The great advancement of model prediction of air quality in megacity like Tokyo could be expected by considering radical chemistry and the coupling with aerosols. Finally future prediction of air quality using some probable scenario of the economy can be released.

【Publications Relevant to the Project】

・Measurements of OH reactivity and photochemical ozone production in the urban atmosphere;
Yasuhiro Sadanaga, Ayako Yoshino, Shungo Kato, and Yoshizumi Kajii
Environ. Sci. Technol., 39, 8847-8852 (2005).

・Development of a measurement system of OH reactivity in the atmosphere by using a laser-induced pump and probe technique;
Yasuhiro Sadanaga, Ayako Yoshino, Keisuke Watanabe, Atsushi Yoshioka, Yoko Wakazono, Yugo Kanaya and Yoshizumi Kajii
Rev. Sci. Instrum., 75, 2648-2655 (2004).

【Term of Project】 FY2009-2013

【Budget Allocation】 160,000 Thousand Yen

【 Homepage Address and Other Contact Information】

http:// atmchem.apchem.metro-u.ac.jp