【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering Ⅱ)

Title of Project : Attosecond and femtosecond pulse radiolysis study

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Research Area : Engineering
Keyword : pulse radiolysis, electron-induced ultrafast reactions, ultrashort pulse electron beam, time-resolved measurement.

【Purpose and Background of the Research】

The reveal of hidden ultrafast reactions or phenomena in material is essential to the creation of new materials or devices, and to the development of new technologies or processes. The pulse radiolysis based on a short-pulse electron beam and an ultrashort laser light is a powerful tool to study the ultrafast electron-beam-induced reactions or phenomena. However, the time resolution is still stopped in the picoseconds or sub-picosecond time region because of electron pulse and other limitations.

In this project, a femtosecond/attosecond pulse electron beam will be generated. The new techniques of a double-decker electron beam and an equivalent velocity spectroscopy are proposed to break the time resolution limitations. A new pulse radiolysis in the femtosecond and attosecond time region is constructed and used to reveal the hidden electron-induced reactions in material.

【Research Methods】

The following researches are carried out for the next pulse radiolysis in the femtosecond and attosecond time region:

(1) Generation and measurement of femto-second and attosecond electron beam
(2) Pulse radiolysis based on double-decker electron beam accelerator
(3) Equivalent velocity spectroscopy

Finally, the pulse radiolysis is used to reveal the hidden electron-induced reactions in material on the femtosecond and attosecond time scale.

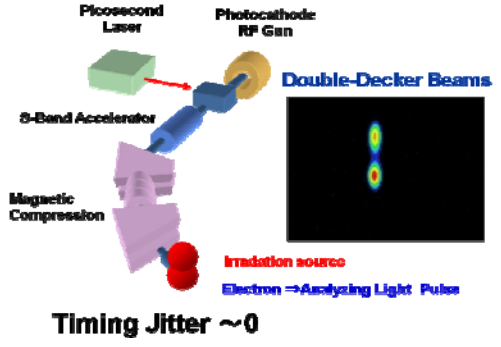

Fig. 1 double-decker electron beam accelerator system for pulse radiolysis

【Expected Research Achievements and Scientific Significance】

The high-brightness electron beams with ultimate low-emittance and femtosecond or attosecond bunch length, which is developed in this project, are also key elements for new developments in accelerator physics.

The pulse radiolysis will open firstly the femtosecond and attosecond time-resolved measurement. The hidden dynamics of intricate molecular and atomic processes in material is expected to be revealed through the experiment. The research achievements (Fig. 2) will open the study and development of new advanced materials in the fields of environment, energy, medical science and nanotechnology.

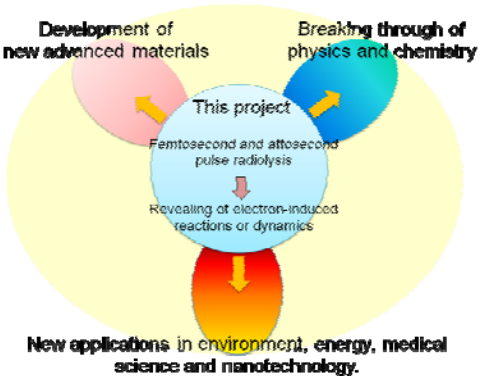

Fig.2 Expected research achievements and scientific significance

【Publications Relevant to the Project】

・J. Yang, T. Kondoh, K. Norizawa, Y. Yoshida, S. Tagawa, “Breaking Time-Resolution Limits in Pulse Radiolysis”, Radiat. Phys. Chem., in press (2009).
・A. Ogata, T. Kondoh, J. Yang, A. Yoshida, Y. Yoshida, LWFA of Atto-Second Bunches for Pulse Radiolysis, Int. J. Modern. Phys. **21**, 447-458 (2007).

【Term of Project】 FY2009 - 2013
【Budget Allocation】 161,300 Thousand Yen
【Homepage Address and Other Contact Information】
http://www.sanken.osaka-u.ac.jp/labs/bsn/project-s/project.htm