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

Title of Project : Deepening and Developing New Aspects of Flash Chemistry

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Research Project Number : 26220804 Researcher Number : 30127170
Research Area : Synthetic Chemistry
Keyword : Fine Chemicals, Flow Microreactor, Reactive Intermediates

【Purpose and Background of the Research】

Most of the reactions in organic synthesis have been developed in macro-scale batch reactors such as flasks. However, flow micro-scale reactors have emerged recently as alternative reactors in organic synthesis.

Extremely fast reactions involving highly reactive, unstable short-lived reactive intermediates are usually very difficult to control in batch reactors. However, by using flow microreactors such unstable intermediates can be generated and transferred to another location to be used in the next reaction before they decompose. Therefore, chemical conversions that are very difficult or practically impossible in batch reactors should become possible using flow microreactors. Such chemistry is called flash chemistry.

Flash chemistry is a chemical synthesis using extremely fast reactions based on flow chemistry. Flash chemistry is expected to complement flask chemistry which has been developed extensively and is widely utilized in laboratory synthesis.

The purpose of the present project is to deepen the concept of flash chemistry and to develop new aspects of flash chemistry.

【Research Methods】

In this study, we will focus on the following points. (1) Analyzing reactions using temperature–residence time contour maps to obtain a deeper insight into the features of reactions in flow. (2) Determining the rates of reactions involving various reactive intermediates such as organic anions and cations in flow. (3) Observing such reactive intermediates by spectroscopic methods such as FT-IR in flow.

Based on the quantitative information of reactive intermediates, we will design new reactors and new reactions involving such intermediates, and we will apply them to synthesis of various organic compounds that are difficult to achieve by conventional batch reactions.

In addition, we are planning to apply the concept of flash chemistry to not only homogeneous reactions, but also heterogeneous reactions involving gas/liquid reactions, photochemical reactions, electrochemical reactions, and reactions using heterogeneous catalyst.

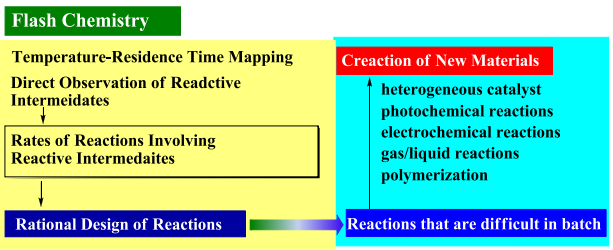

Figure 1. Research Methods and Plans

【Expected Research Achievements and Scientific Significance】

One of the most significant features of flash chemistry is that the reactions involving short-lived reactive intermediates are controlled by shortening the reaction time in time scales of seconds or less using flow microreactors. Therefore, flash chemistry enables various types of reactions that are very difficult or practically impossible to perform in batch chemistry. Flash opens up a new possibility of chemical synthesis in science labs and industrial production, and will raise the power and speed of organic synthesis.

【Publications Relevant to the Project】

・Flash Chemistry. Fast Organic Synthesis in Microsystems, Yoshida, J. Wiley, 2008.
・Flash chemistry: flow chemistry that cannot be done in batch. Yoshida, J.; Takahashi, Y.; Nagaki, A. *Chem. Commun.* **2013**, *49*, 9896.

【Term of Project】

FY2014-2018

【Budget Allocation】

147,700 Thousand Yen

【Homepage Address and Other Contact Information】

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