



第167回触媒化学研究センター談話会

演 題 : Spatio-Temporal Addressing of Surface Activity

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(Pt 単結晶表面で CO 酸化反応中に
時空間パターンが生じることをは
じめて見いだした人です。)

(Fritz-Habor-Institute der Max Plank Gesellschaft Berlin)

日 時 : 2004年3月5日(金) 15:30 - 16:30

会 場 : 北海道大学創成科学研究棟

4階 セミナー室 4 - 215号室

要 旨 : Simple surface reactions like the CO-oxidation on single crystal Pt surfaces show a rich variety of pattern formation under specific reaction parameters. The interaction of a multitude of micrometer scale concentration waves and fronts on the surface complicate our understanding the underlying mechanisms for such patterns. Experiments with modified catalytic activity using stationary, inactive boundaries have therefore been designed to isolate individual features (for example single pulses) and interaction mechanisms in order to study them quantitatively [1].

Recently we have been able to dynamically change the surface catalytic activity in real time and space by focusing an addressable laser beam to differentially heat a Pt(110) single crystal surface [2]. Imaging the reactant local coverages with an ellipso-microscope enabled us to close the loop between sensing and actuation, both being spatio-temporally resolved. Pulses and fronts, the basic building blocks of patterns, can now be formed, accelerated, modified, guided and destroyed at will. The combination between image processing and feedback allows the design and implementation of new classes of non-local evolution rules. Exploring the types of behavior accessible to such "arbitrary rule" closed-loop systems, merging physics and software to influence and control the behavior, is an open-ended task, several aspects of which we are currently pursuing. One of the directions suggested by this approach is the design of spatio-temporal feedback laws to optimize average performance of the catalyst, including selectivity for the case of more complex catalytic pathways.

A temperature heterogeneity moving along a line may ignite waves along its path, or can drag preexisting pulses. In particular, we studied how a traveling chemical pulse is "dragged" by a localized, moving temperature heterogeneity as a function of its intensity and speed. The acceleration and eventual "detachment" of the wave from the heterogeneity is explored through simulation and stability analysis [3].

For the exploration of catalytic reaction energetics at low pressures we have studied ultra thin (~200 nm) Pt(110) metal single crystals. We discovered a new chemo-thermo-mechanical instability in this regime, in which catalytic reaction kinetics interact with heat transfer and mechanical buckling to create oscillations [4]. The small thermal capacity of these ultra thin crystals allows a new approach in measuring reaction rates.

《連絡先》 北大触媒化学研究センター 表面活性構造物性

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