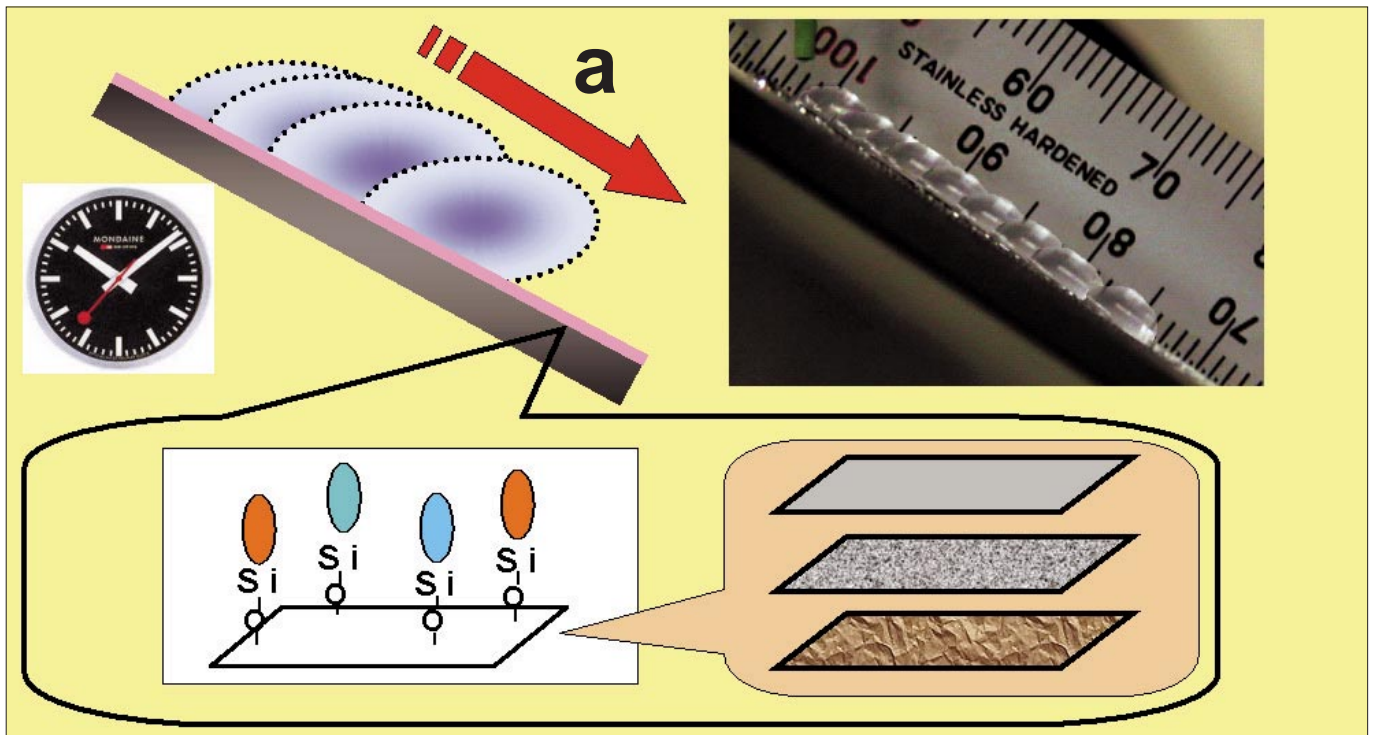


# Nakajima“ Super Hydro philic/phobic Surface ”project

Project Leader

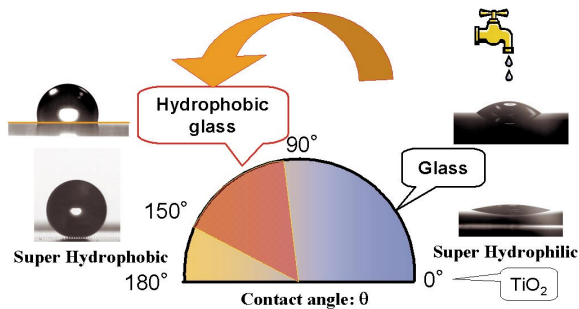
Akira Nakajima



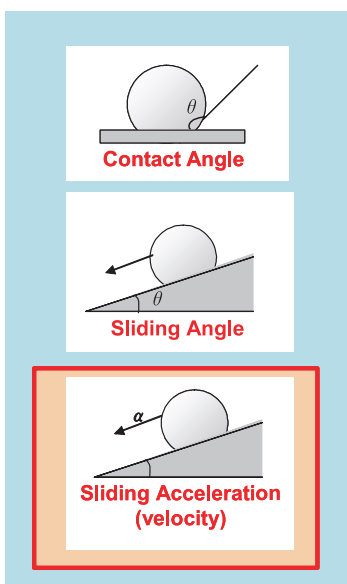
Sliding of water droplets on a hydrophobic surface

Wettability and repellency are research subjects at the border between physics and chemistry, and are important properties of solid surfaces from both fundamental and practical aspects. While the contact angle of water has been commonly used as a criterion for evaluating the static hydrophobicity of the surface, this alone is inadequate for evaluating the dynamic hydrophobicity, which is the sliding behavior of water droplets. Recently, recognition of the importance of dynamic hydrophobicity is growing in various industries such as the glass, automobile, and electronics industries. So far, the sliding angle (the angle when a droplet of water of a certain weight begins to slide down an inclined plate) is commonly employed as a criterion for assessing the dynamic hydrophobicity of a solid surface.

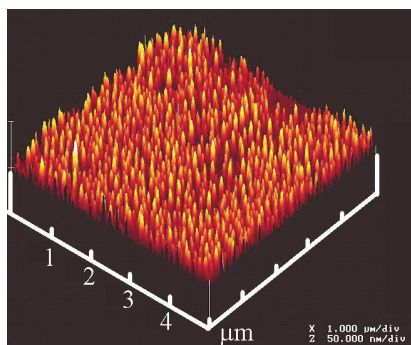
"The surface shape of industrial items is generally determined by their size, function and design; the value of sliding angle does not include information on the sliding acceleration or velocity. Information on how fast the droplet can be removed from the surface at a certain tilt angle is becoming more important than that on the lowest tilt angle at which the droplet slides down. However, a fundamental understanding of the factors and their contribution to the overall sliding acceleration or velocity remains insufficient. In this project, we will try to clarify the relationships between the sliding acceleration of droplets and chemical or physical properties of the surface. We will then establish evaluation methods and facilities for measuring sliding acceleration, and develop functional surfaces by controlling wettability.



**Fig.1 Contact angles and droplet morphologies**



**Fig.2 Contact angle, sliding angle and sliding acceleration**



**Fig. 3 AFM image of Si surface coated with fluoroalkylsilane**

## Contents of Research

### 1) Determination of dominant factors

Interaction with substrate materials is expected to affect the stability or molecular arrangement of the liquid in the droplet when the coating thickness is small and there is ionic chemical bonding of the substrate surface. In general, relatively thick (of mm order) polymer coatings are applied to organic substrates, so this effect can generally be ignored. The stability and molecular arrangement on the surfaces with various chemical compositions will be evaluated by computer simulations in this project. Moreover, sliding acceleration on various coating surfaces will be evaluated by experiment, then factors that govern the water-shedding properties of liquid will be determined in terms of the structures and chemical species on the surface, including the interaction from the substrate.

### 2) Establishment of evaluation methods

Based on the measurement of sliding acceleration on various surfaces, evaluation conditions and procedures will be established. In this project we will develop a facility for measuring this property, and determine concepts for designing surfaces with high sliding acceleration of liquids.

### 3) Fabrication of functional solid surface

We will examine the effect of external force on the motion of a liquid droplet on the solid surface, then fabricate various new functional devices such as sensors or micro-pumps by controlling surface wettability or its difference. The goal of our project is not only a fundamental understanding of the surface science but also technology transfer of our results to industry through intellectual property.

## Organization of Research

**Term:** April 2004 to March 2007

**Members:** Project leader, several regular scientists, several part-time scientists and collaborating research staff

**Location:** Kanagawa Science Park (KSP) East Bldg. 4th floor