Nikon Corporation

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1. The Challenge of Micromachine Technology

Nikon has been engaged in technical development related to micromachines for a relatively long time, including working in cooperation with the Yoshida Nano-Mechanism Project in 1986 to develop a probe for a special scanning tunneling microscope. Nikon has also developed its own micromachine devices, including the following:

- Probe for a scanning probe microscope
- 3-dimensional accelerometer
- Microgripper
- Microknife
- Non-cooled infrared image sensor

2. Development of Micromachine Technology

Here, we will introduce some representative devices and related technologies developed by Nikon thus far.

To begin with, we will introduce a microgripper for manipulating small objects under a microscope as an example of bulk micromachining (Fig. 1). Thin film fingers having a thickness of 0.7μm and a length of 600μm are controlled under a microscope using a master-slave system. With this microgripper, it was possible to manipulate eggs and protozoa between 20 and 100 microns in size using a gripping force of about 10 nN. The gripper was also used to construct a system capable of performing in-situ measurements to determine the hardness of microobjects. Through this development, we established basic processing technologies and evaluation technologies regarding self-supporting thin films. This microgripper can be considered a special micromachine for its capacity to operate in a solution.

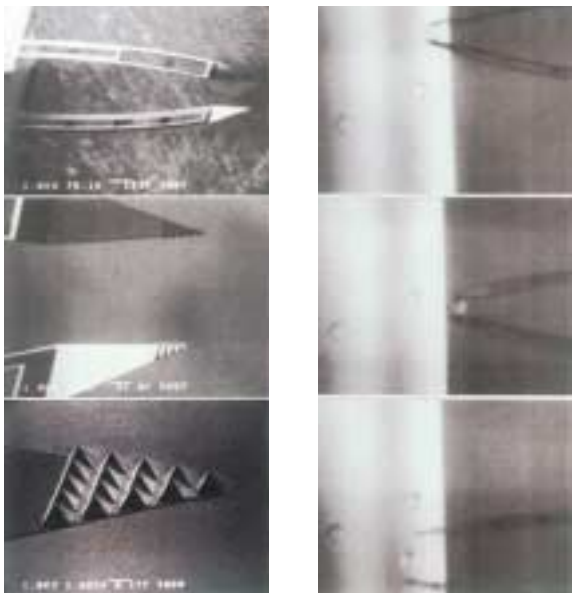

Fig. 1 External view and operations of the microgripper

Next, we will introduce a non-cooled infrared sensor as an example of surface micromachining (Fig. 2).

Infrared light received from the back of a substrate is converted into heat, causing the bimorph unit to deform, which in turn tilts the mirrors integrated in the bimorph unit. The slopes of the integrated mirrors enable thermal images to be obtained by a 2-dimensional CCD that detects all visible light. Recent devices have been successful in obtaining accurate thermal images without requiring special temperature control by canceling deformation caused by temperature changes in the outside air. Basic properties of the infrared sensor include a pixel size of 55μm, a resolution of 160x120 pixels, and a sensitivity of 2.8 mV/K.

3. Future Challenges

Nikon hopes to continue developing useful micromachines for data communications and biotechnology, while utilizing aspects of its technologies such as the ability to drive devices in liquid and high-rise MEMS structures.

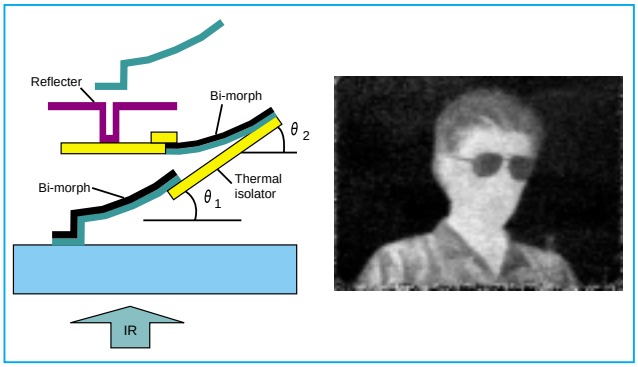

Fig. 2 Cross-sectional view of the non-cooled infrared sensor and a generated image