Automatic Connection/disconnection Mechanism of Microconnector

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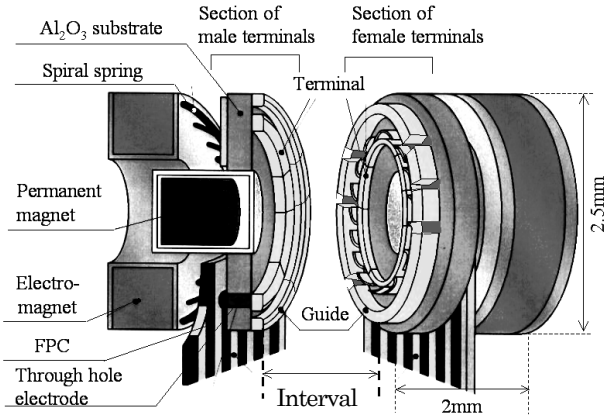
A multiple distributed micromachine system is needed to cover a certain working area and fulfil the intended function. One system is chain-type micromachines for the inspection of the outer surfaces of tube banks. The task is carried out cooperatively by micromachines which assemble and are connected to each other at the desired tube. But the microconnectors have yet be developed that let micromachines automaticallyjoin and separate with each other.

We have developed a microsonnector with an automatic connection/disconnection mechanism employing magnetic force (Fig.1). The microconnector is 2.5mm in diameter and 2mm in thick.



The required features are as follows;(1) Connection/disconnection is available at the interval of 500±100 μm and within the axial displacement of 100 μm. (2)To miniaturize the actuator, the required magnetic force has to be small as possible. To realize them, we developed a new terminal/guide system and the noble actuator with sliding permanent magnet. By sliding magnet system, the required magnetic force is suppressed.

To obtain a reliable connection with the small contact force, the terminals and guides must be perpendicular to the substrate of the microconnector and have high aspect ratios. These structures are fabricated using the deep X-ray lithography technique. Metallic microstructures are obtained by filling resist templates by nickel electroforming and then stripping the resist (LIGA-like process)(Fig.2).

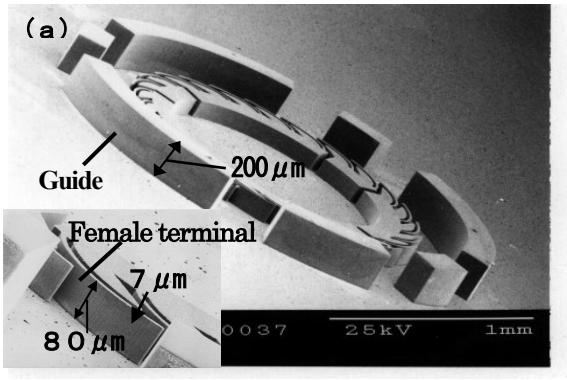


Fig. 2 SEM micrograph of terminal and guide (female).

As shown in the Fig.3, connection was possible for the microconnector interval up to 600 μm, however, it was difficult to completely separate the two sides when the interval was less than 420 μm. These results agree well with the calculated results for automatic connection/disconnection. For the connector interval of 500 μm, even if the maximum displacement of two sides on the microconnector plane was 160 μm, connection/disconnection was possible.

We confirmed the automatic connection/disconnecton and electrical stability of microconnector.

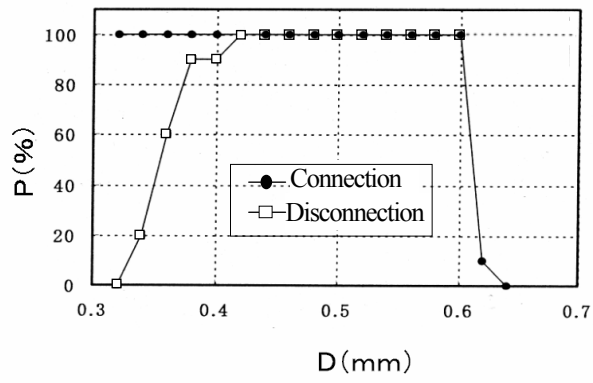


Fig. 3 Probability of automatic connection / disconnection (P)as a function of interval(D) of the microconnector.