



Study on improvement of micromanipulation system by using a functional surface with a groove structure

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Abstract

Recently, the product itself has been miniaturized by the rapid spread of smartphones and the wearable terminal of various devices. Therefore, the demand for micro parts including chip capacitors and MEMS (Micro Electro Mechanical Systems) which constitute the product body is increasing. With that, the improvement of the function of the micromanipulation equipment which can operate the minute object of the micrometer order is required. On a normal scale, a force proportional to the third power of the scale such as gravity exceeds a force proportional to the second power of the scale such as Imitation force, and becomes a dominant force. However, the dominant force in the microscale is the Imitation force. This phenomenon is called the scale effect, and it shows that the physical phenomenon in the microscale is different from the physical phenomenon in the usual scale. From this fact, in the micromanipulation work, the natural drop of the object by the gravity can not be expected, when the gripped minute object is placed at the optional position. That is, it becomes difficult to arrange the object at an arbitrary position. In this paper, we propose a method to place an object at an arbitrary position by generating a force between the floor and the object. The proposed floor surface has fine grooves in which enough liquid is injected to generate a liquid bridging force between the floor surface and a small object. The width of the groove can be reduced by applying a surface load to the floor in the direction perpendicular to the direction of the groove. By doing so, it is possible to generate a liquid bridging force suitable for the size of the object. In addition, as the grooves become finer, capillary action occurs in the grooves. From this fact, it is possible to supply the liquid to the groove without depending on the attitude of the floor surface. By utilizing the floor surface proposed here, the speed and stability of the operation in which the object in the micromanipulation work is put on the floor surface are improved, and it leads to the development of the micromanipulation function.

Keywords: Micromanipulation, Functional floor, Liquid bridging force