

## ULVAC Inc.'s MEMS Foundry Services

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### 1. ULVAC's approach to MEMS

ULVAC has developed equipment for MEMS and at the same time we have been developing the associated processes. For example, we are offering equipment that overcomes issues that were considered difficult in the past such as deposition and etching of functional materials like high-permittivity film and magnetic film, deep etching quartz and Si, or dry etching etch-resistant materials with low vapor pressure and so on. For example, equipment such as the SME-200 sputter machine for high-permittivity film and SAW device electrode formation; the CME-200 CVD machine for silicon oxide and nitride films; the NLD-6000 which demonstrates its power in deep etching quartz; and the NLD-Si that can deep-etch Si are evaluated highly in the field of MEMS.

In addition, besides giving polymer film itself the functionality of water repellency, hydrophilicity, biocompatibility, and antimicrobial properties, ULVAC's vapor deposition polymerization method can form a uniform polymer film even in the deep parts of minute structures. These properties are drawing attention to the method as a technology perfectly suited to MEMS. In parallel with the development of this machinery, ULVAC is aggressively pursuing challenging new development in the bio, fine mechatronics and fine chemicals sectors.

The MEMS foundry service, started in November 2003, is positioned to leverage these equipment and process developments for production of MEMS devices. In other words, as well as providing services incorporating ULVAC's technologies into processing as a foundry managed by an equipment manufacturer, we are leveraging our technology and know-how gained through development of equipment and processes. In this way we are expanding our mission by providing rapid service to meet our customers' requirements for new processes and equipment.

### 2. The features of ULVAC's MEMS foundry services

Since we started the foundry, the response has exceeded our expectations. Besides production of MEMS devices, requests have come in for single processes like deposition of single films or etching. We are making great efforts to upgrade our equipment and improve our processes in response to difficult orders, and we believe that as the foundry of an equipment manufacturer, we have a distinctive offering.

As a rule, for devices, we ask the customer to provide the design, while the foundry faithfully fulfills production. The basic philosophy of ULVAC's foundry service is to enable the customer to carry out the design freely without any preconceptions even when new processes are required, or when it is difficult to judge which material to use, then to pass the production baton to ULVAC whereupon we manufacture the product to specification and hand it back. Naturally, we work to ensure that there are pricing benefits too.

### 3. Introducing ULVAC's MEMS manufacturing

Here we provide an example of ULVAC's in-house device manufacturing. When we developed our MO-CVD equipment for LEDs, we produced a prototype blue LED to evaluate the equipment characteristics. Figure 1 shows an emission test ( $\lambda = 440.9 \text{ nm}$ ). The quantum well of the luminescent layer is formed of InGaN, sandwiched between p-AlGaN and n-GaN to form an LED.

Figure 2 shows an example of Si deep etching. This is a processing example of ULVAC's proprietary NLD-Si method. It achieves Si etching with a width of  $0.2 \text{ }\mu\text{m}$ , a depth of  $6.5 \text{ }\mu\text{m}$ , and an aspect ratio of 30 or more.



Figure 1. Blue LED



Figure 2. High aspect etching using the NLD-Si method

### 4. Future efforts

As we saw above, ULVAC's MEMS foundry aims to provide a wide range of processing technologies in a timely manner. We have a comprehensive range of lines, from deposition and etching to bonding and dicing, and we are currently augmenting our facilities. At our current scale of operations, we are accepting orders for small-lot production suited to R&D level manufacturing. For the future, we plan to expand into larger-scale processing. Besides integrated production for our own company, the ULVAC MEMS foundry also welcomes subcontracting orders in our area of specialization. In terms of quantity, we accept orders starting from one wafer. Please address enquiries to the Micromachine Center or through the ULVAC website.

<http://www.ulvac.co.jp>