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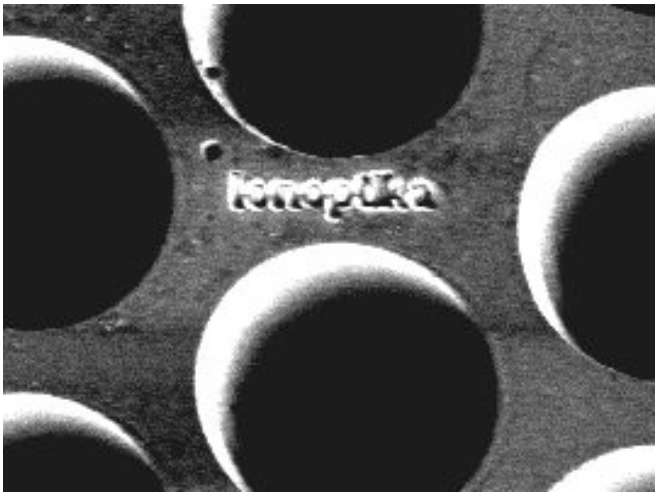
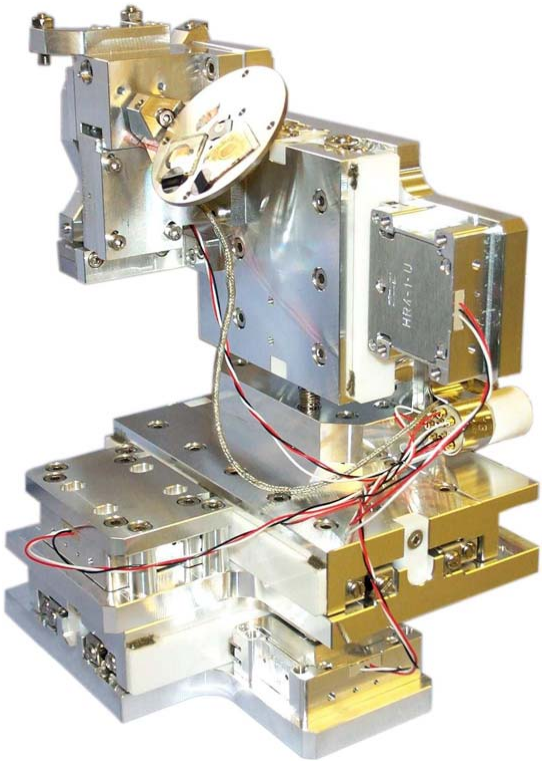
Renishaw scales facilitate micro-machining research

Special equipment has recently been installed at the University of Southampton by Ionoptika Ltd., for research into one of the most demanding of applications; micro-machining. Among the highly specialised suppliers involved is Renishaw, whose RG2 scale and RGH25 UHV readheads provide the crucial means of positioning for the nanometric movements required. People outside this discipline often find it hard to comprehend just how minute such work is – for example, Ionoptika's full company logo can be etched 20 µm wide on a typical metallic screen mask.



A close-up of the Ionoptika imprint, the logo is 20 µm in width, and the first 'i' just 70 nm wide

Ionoptika has designed and constructed this instrumental system by incorporating a multi-axis Nanomotion sample stage, supplied by Heason Technologies of Chichester. The whole integrated micro-machining assembly is housed within a vacuum casing and mounted on a high-stability platform, isolated from all external vibrations



A multi-axis sample stage fitted with piezo-ceramic motors and Renishaw scale and readhead system.

Andy Barber, Ionoptika technical manager, comments "Renishaw's scale and readheads were specified for the critical measuring/ positioning functions because they are able to maintain the necessary accuracy. They can also cope with the demanding environment - to avoid 'out-gassing' problems, the ultra high vacuum conditions require the entire equipment to be periodically 'baked' at temperatures of up to 120 ^{o}C."

Perfectly matched to piezo ceramic motors

An interesting feature of the multi-axis, sub-micron accuracy sample stage is its use of piezo-ceramic 'standing motion' motors. "Matching the encoders to these motors has proved very effective" claims Mr Barber. The result is continuous smooth motion combined with high resolution, zero backlash, and fine positioning accuracy, which is typical of piezo-electric devices.

Flexibility and ease of integration

Andy Barber has no doubts that the RG2 linear encoder system, with 50 nm resolution, incorporates the ideal tape scale for such an application. "The tape's flexibility has been amply demonstrated here by the way it has been used on the partial-arc axis. The

RGH25 readhead is ideal, as it is compact, robust and compatible with the UHV environment," he says.

High repeatability vital

Linear movements across the workpiece can be up to 50 mm, with a requirement to return to features previously worked on. The system must have high resolution and high repeatability to achieve this, which is the key benefit of the encoders. To achieve sub-micron precision, Ionoptika scientists have written their own programs for the computer-controlled 4-axis stage system, including integrated micro-machining software.

To demonstrate the minute scale of this work, one program etches the Ionoptika company logo on a metallic screen mask. The entire company name is perfectly reproduced within the width taken by a single hole, 20 µm wide – a highly precise system, with Renishaw's scale and readheads key to this precision.

Future developments

According to Southampton University's Chris Finlayson, he plans to conduct the following studies in the Physics Department using the new equipment: 1) Patterning of 2D photonic crystal structures into various dielectric waveguides; 2) Etching of sub-micron sized holes through inert metal thin-films in order to examine light/plasmon interactions; and 3) Lateral patterning of waveguides and integrated optical circuits.

Company background

Located within the Chilworth Science Park (Southampton), providing an environment and facilities suited to modern science-based business, Ionoptika was created with the co-operation of Southampton University. It is fully equipped with assembly and test facilities for ion guns, sources, or other high vacuum instrumentation. For this particular application a 25 kV gallium liquid metal ion gun of <30 nm special resolution has been employed.

RGH25 UHV readhead
and RGS20-S scale

Ionoptika scientists are experts in ion beam systems for highly specialised imaging, on both elemental and molecular features, including single cell systems. With a frequent need to look at such a cell and come back to it, positioning accuracy is extremely important.