THE DEVELOPMENT OF MEMS-BASED TIME-OF-FLIGHT SCANNING FORCE MICROSCOPY

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ABSTRACT

We describe a cantilever device for a novel 'Time-Of-Flight Scanning Force Microscope (TOF-SFM)' concept. The cantilever device consists of a switchable cantilever (SC), a microfabricated extraction electrode, and a LEGO-type microstage. It allows quasi-simultaneous topographical and chemical imaging of a sample surface to be performed in the same way as with conventional scanning probe techniques. This is achieved by the micromachined SC with a bimorph actuator that provides a reasonable switching speed in comparison with bulky systems. Secondly, a short tip-electrode distance to minimize the ions extraction voltage can be realized by LEGO-type microfabrication. The measured SC tip deflection is ~100 μm at 35 mW, corresponding to an estimated heater temperature of ~250 °C. The maximum switching speed between the two modes, TOF and SFM, is ~10 msec, and the sensitivity $\Delta R/R$ of an integrated piezoresistive strain sensor is $\sim 6.7\times 10^{-7}$/nm. The tip-electrode distance is only 10 μm. The TOF-SFM is currently being integrated in an ultra-high-vacuum system to carry out experimental results and the details of the research will be introduced in the 2nd US-Korea NanoForum.

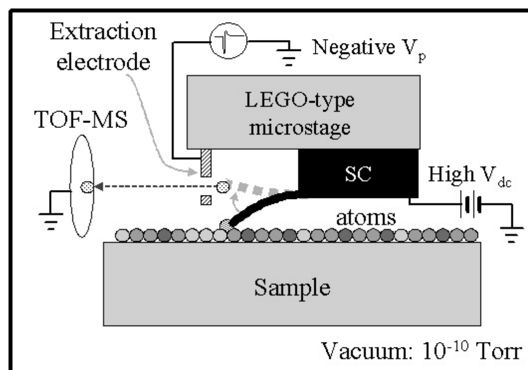

Fig. 1. The concept of the TOF-SFM

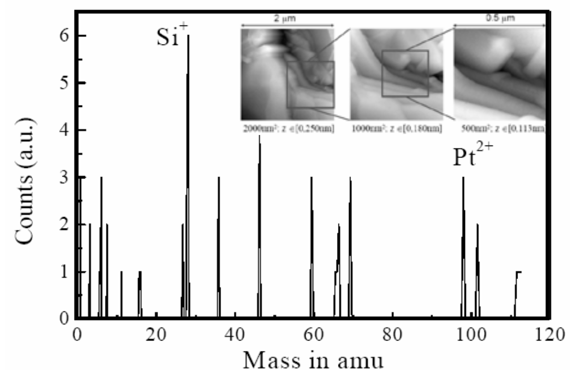

Fig. 2. Mass spectrums of a Pt-coated tip
(The inset is a surface image by TOF-SFM)