The nanoelectromechanical device of laterally deformable cantilevers array

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Laterally deformable tunable grating structures, which have potential application in displays, sensors[1], and optical switches for communications[2], have been realized by several groups. Here we demonstrate the realization of a novel nanoelectromechanical system (NEMS) device [3] and the characterization of its performance. We will also discuss its application as a mass sensor.

The structure of the NEMS device is a laterally deformable double-finger interdigitated cantilevers array [**Fig. 1**], which were made on SiO_2/Si surface covered by a thin metal layer. The device was manufactured by electron beam and nanoimprint lithography [3]. When a bias voltage is applied, the cantilevers of the device will bend to each other due to electrostatic force.

By applying DC voltage and AC voltage with different frequency, the deflection and oscillating behaviors of the cantilevers were studied under microscope. Those behaviors were related to the intensity of diffraction pattern by measuring it with a digital camera or a photodiode [**Fig. 2**]. The results show that the device could be used as an optical switch and an accelerometer. The resonance frequency of the cantilevers array was also determined. After deposition of 5 nm Au layer, the resonance frequency was seen to shift about 200 kHz [**Fig. 3**], indicating that the device could be applied as a mass sensor.

Reference:

[1] B. E. N. Keeler, D. W. Carr, J. P. Sullivan, T. A. Friedmann, and J. R. Wendt, Opt. Lett. **29**, 1182 (2004).

[2] Y. C. Tung and K. Kurabayashi, App. Phys. Lett., **86**, 161113 (2005)

[3] G. Luo, I. Maximov, D. Adolph, M. Graczyk, P. Carlberg, S. G. Nilsson, D. Hessman, T. Zhu, Z. F. Liu, H. Q. Xu and L. Montelius, Nanotechnology **17**. 1906 (2006)

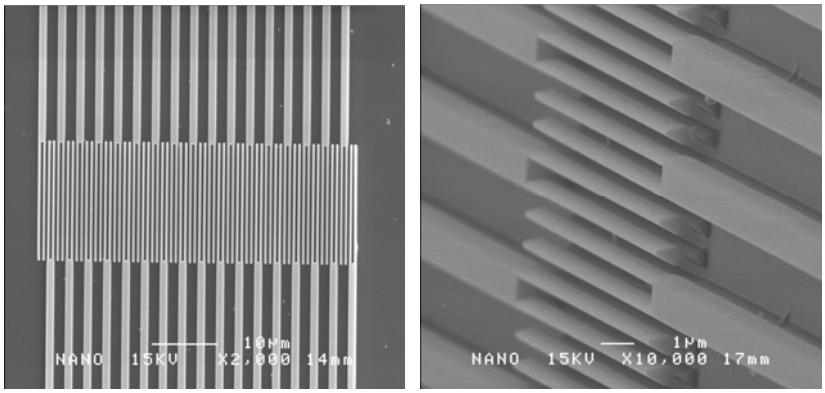

Fig. 1 SEM images of the NEMS device: top view (left) and side view (right). The width of each cantilever is 200 nm and the distance between them is 500 nm. Total area of the cantilevers array is 50 x 15 μm^2.

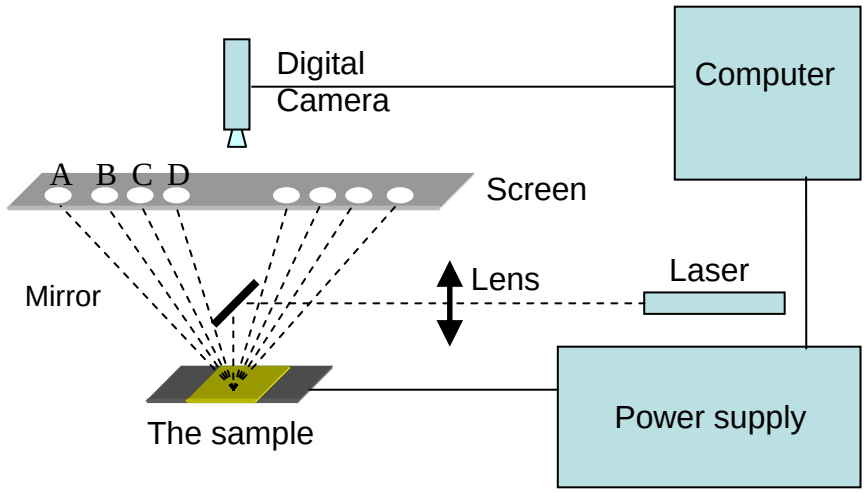

Fig. 2 The setup scheme for the measurement of diffraction pattern intensity.

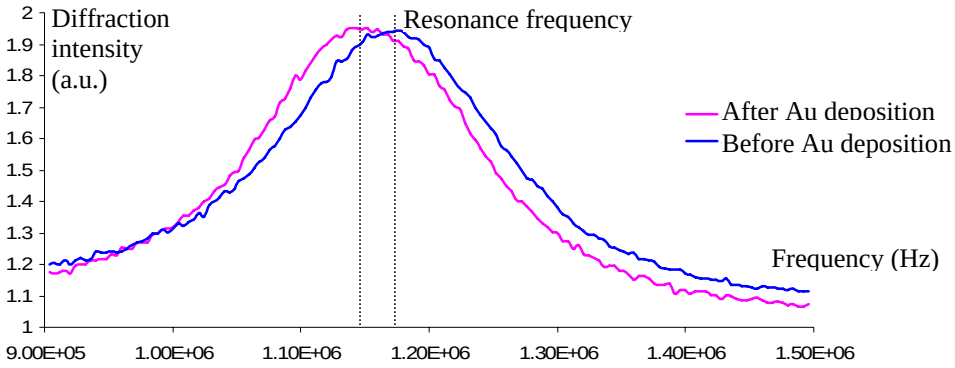

Fig. 3 The comparison of resonance frequency before and after Au deposition.