

Silica Based Micro-Cantilevers Fabricated Using Direct UV Writing and Micro Machining For Chemical and Physical Sensing Applications

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Cantilever-based sensors have received increasing interest over recent years, offering a completely new type of miniaturised transducer with both chemical and physical monitoring capabilities [1]. This paper presents a resonant silica micro-cantilever with direct UV written Bragg gratings intrinsically defined within it, illustrated in Figure 1 (a). To obtain quantitative and qualitative measurements the cantilever is mechanically resonated and the spectral variations in a 'sensor' Bragg grating monitored and cross referenced against a Bragg grating in the bulk. The miniaturised device offers remote, multiplexed sensing capabilities that are conducive to flammable environments.

Device fabrication is uniquely achieved through a combination of surface micro machining and direct UV writing in a silicon-on-silica platform, using a three stage fabrication process. The first stage uses a precision dicing saw to cut the cantilever's 'outline' into the wafers silica layer, exposing the underlying silicon. This novel technique allows for rapid prototyping, as it does not require photolithograph and etching steps that can be expensive and time consuming, for small device quantities. The second stage of fabrication defined the Bragg grating elements using a direct UV writing technique [2]. In the final stage of fabrication the exposed silicon was wet etched using KOH such to liberate the silica cantilever from the underlying silicon.

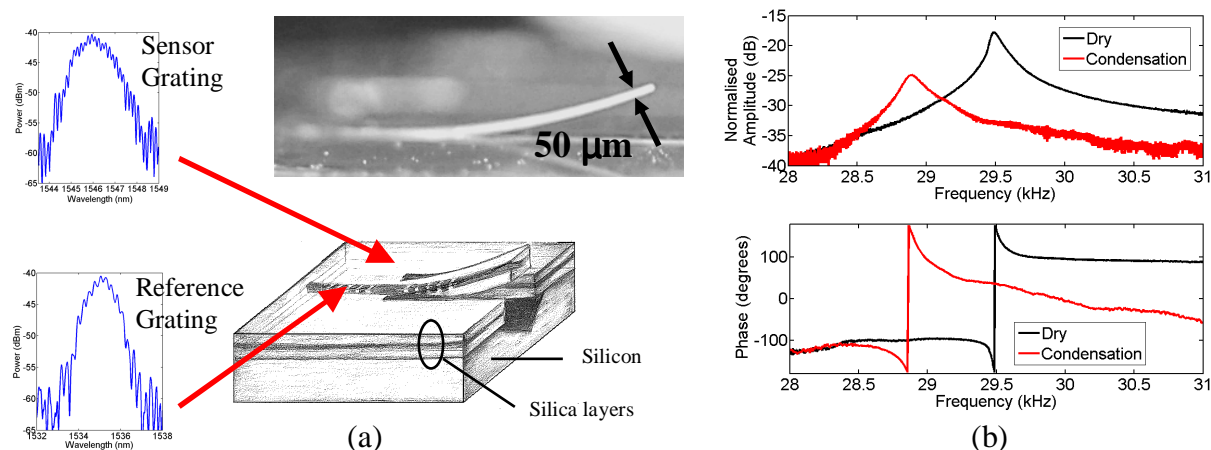


Figure 1 (a) Schematic and photograph of the fabricated silica cantilever. (b) The resonant frequency shift as a result of deliberately induced condensation.

The fabricated cantilever reported has a width of 55 μm a thickness of 50 μm and a length of 4 mm. Figure 1 (b) depicts the shift in mechanical resonance of the fabricated cantilever as a result of deliberately induced water condensation on the surface of the device.

We have demonstrated for the first time a direct UV written Bragg grating chemical and physical sensor, based upon micro fabricated cantilevers. We shall report on the micro fabrication techniques and the chemical and physical sensing capabilities of the cantilevers, including the multiplexing of cantilever sensing elements upon a single integrated chip.

[1] N.V. Lavrik, M.J. Sepaniak, P.G. Datskos, Cantilever transducers as a platform for chemical and biological sensors, Review of Scientific Instruments, 75, 7, 2229-2253, (2004)

[2] G. D. Emmerson S. P. Watts et al. Fabrication of directly UV-written channel waveguides with simultaneously defined integral Bragg Gratings, Electronics Letters, 38, 1531-1532, (2002)