Silica Microbeams for Tunable Bragg Gratings

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Microbeams integrated with optical components have found applications in telecoms and sensing applications[1][2]. We present fabrication, characterisation and modelling of silica microbeams containing an integration optical waveguide and Bragg reflectors. These optical elements, fabricated using direct UV writing process, have applications in telecoms and sensing[3]. Thermal tuning of the integral Bragg gratings is enhanced and the energy requirements greatly reduced by a factor of 50.

The ability to tune a Bragg grating's reflected wavelength provides a route to numerous potential applications such as tunable add/drop multiplexers. While this has already been achieved in fibre optics there are situations where the planar format has advantages in terms of compactness and integration. Of the possible tuning mechanisms, temperature tuning is most common, yielding wide tuning ranges as well as uniform spectral response. Temperature tuning can however suffer from power inefficiency and poor time response due to the large thermal mass of the device. Locating the optical elements in a microbeam is an elegant way to provide localised tuning to a small thermal mass, thereby increasing energy efficiency and reducing crosstalk with other components on the device. Silica microbeams have been fabricated using a series of microfabrication techniques including micro-milling, KOH etching of silicon and evaporative metal deposition. The resultant devices are geometrically uniform and surprisingly robust although only 100µm wide.

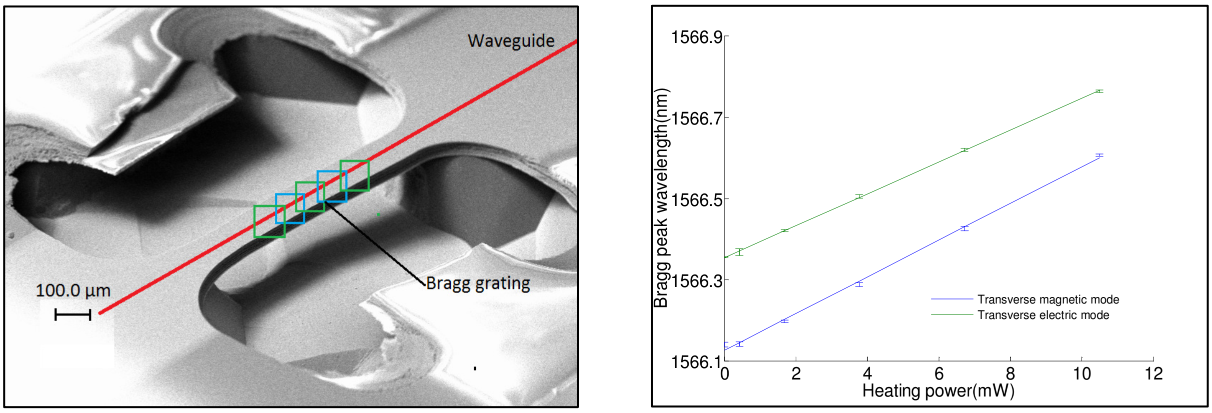

Figure 1 (a) Scanning electron microscope image of a microbeam with annotations showing location of waveguide and Bragg grating (b) shows tuning of Bragg wavelength as a function of applied power.

The devices characterized show that the observed Bragg peak shift is close to linear with the applied electrical power. The data in figure 1 shows a tuning of almost 0.5 nm with 12 mW of heating power.

Another potentially useful property of microbeams is elastic buckling[4]. Buckling either occurs following fabrication due to the stresses caused by the silica deposition process or can be induced by other forms of actuation such as thermal stress. Utilizing buckling in thermal tuning could allow tuning between bi-stable states with no requirement for continuous energy supply.

We shall present our findings including the fabrication and characterization of microbeam devices and applications of a tunable Bragg grating.

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