Tunable optical filter

We present a compact tunable optical filter for spectroscopy applications. The filter offers a transmission bandwidth of ~0.01 - 1 nm and continuous tuning of a single transmission line over a range of up to 100 nm. Tuning is achieved using a piezoelectric actuator controlled via a simple low voltage input and the transmission wavelength can be modulated or scanned at frequencies exceeding 10 kHz.

The filters are based on a microscopic etalon (microcavity) that has been developed in our lab. The mirror separation of a few micrometres leads to a free spectral range of 10 - 100 nm. High quality mirror coatings provide finesses of up to 100,000. The tunable filter unit is a compact module that can be placed directly in a beam path such that the incident light is focused through the etalon in the normal way. In addition to spectral filtering, the etalon provides spatial filtering of the beam such that the output is a near-perfect Gaussian mode. The output mode structure can be engineered to high precision during manufacture of the etalon.

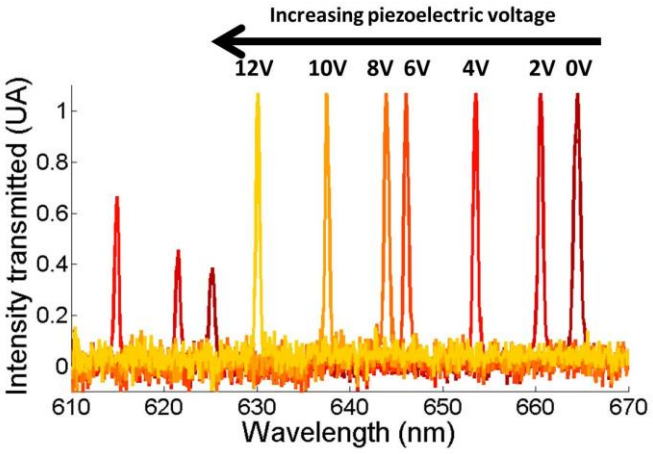

Fig. 1 Filter transmission showing wide range single mode tunability. The transmission lines indicated are TEM_{00} modes (see text). The weaker transmission lines below 625 nm are TEM_{01} modes.

By incorporating precision fabricated concave mirrors with radii of curvature down to 1 µm, the filters display true single mode tuning over a large wavelength range. Figure 1 shows an example of filter transmission through TEM_{00} etalon modes tuned between 665 nm and 630 nm. The longest wavelength TEM_{01} mode is at 625 nm, thus demonstrating true single mode behaviour over the TEM_{00} tuning range and eliminating the need for perfectly mode-matched input coupling.

We anticipate that this tunable filter may be used in conjunction with a supercontinuum laser source and a monochromator that provides ~nm output line widths. The combined settings of the monochromator and the filter would result in a narrow band light source that is continuously tunable over large spectral ranges.

We have patent protection for the tunable filter described here and are currently looking for companies to help us develop commercial products. We are also working on sensor platforms and miniature dye lasers based on the same microcavity technology. For more information on any of these programmes or to register your interest please contact us using the address below.

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