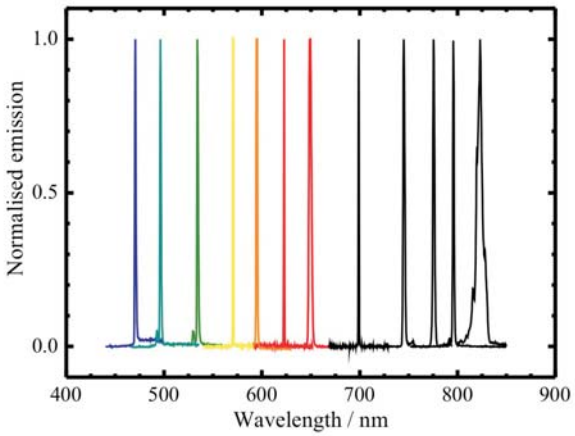
COSMOS lasers

Laser specifications

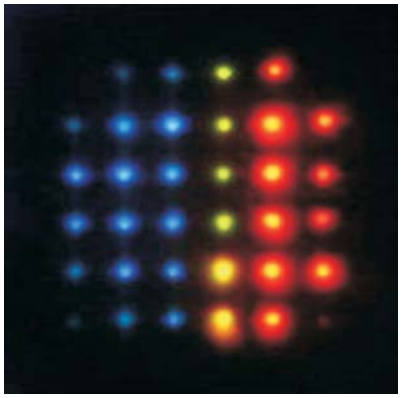
- Continuously tuneable output: 450 - 850 nm
- Extremely high efficiency: 60 %
- Up to 20 μJ/pulse output (P_{pk}~ kW, P_{av}~ 20 mW)
- Pulsed operation: 100 ps to 10 ns
- Quasi-continuous repetition rate: up to 5 kHz
- Linewidth: < 0.05 nm (controllable)

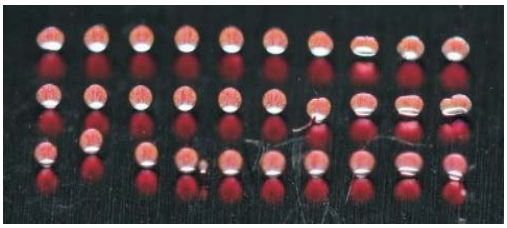
Broadband visible-NIR tuneability



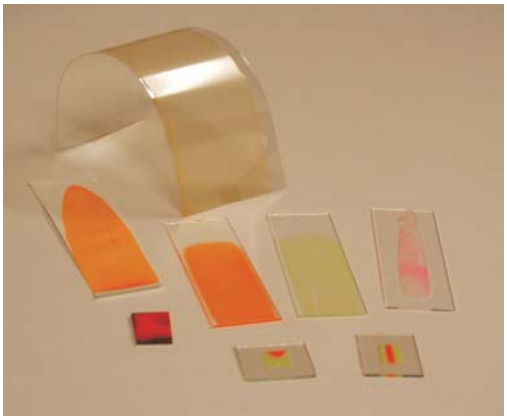
COSMOS tuneable laser demonstrator

Simultaneous multi-wavelength emission





Inkjet printed and paintable LC lasers



Key benefits

- Ultra-compact
- Simple, low-cost manufacture
- Compatible with silicon processing technology
- Inkjet printable onto arbitrary (including flexible) surfaces
- Semi-disposable cartridge lasers
- Retro-fitted tuneable module for fixed-wavlength systems
- Simultaneous multi-colour outputs
- Bespoke laser emission characteristics

Any colour, any time, anywhere

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Liquid crystal tuneable laser technology

COSMOS tuneable lasers are based upon liquid crystal laser technology, developed by scientists at the University of Cambridge, United Kingdom.

The lasers have 3 principal components:

1D photonic band-gap resonant cavity:

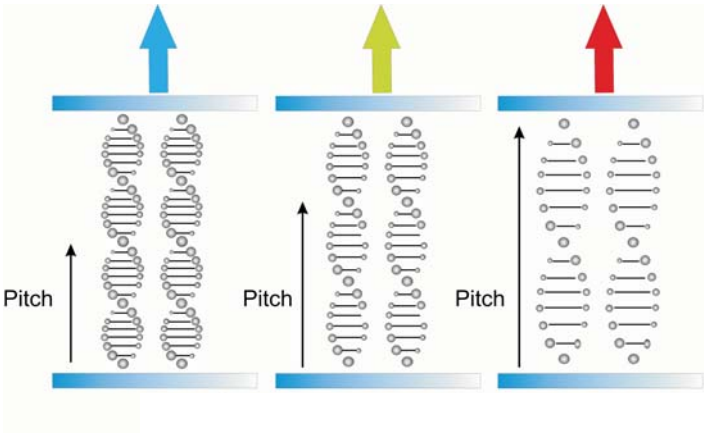
Chiral nematic liquid crystal molecules spontaneously align themselves into a helical microstructure. This periodic structure provides selective wavelength reflection, enabling a self-assembling mirrorless cavity only 10 microns thick.

Organic laser dye gain medium:

Fluorescence from a soluble laser dye is designed to coincide with the band-edge of the photonic band-gap structure. This provides optimal conditions for highly efficient lasing.

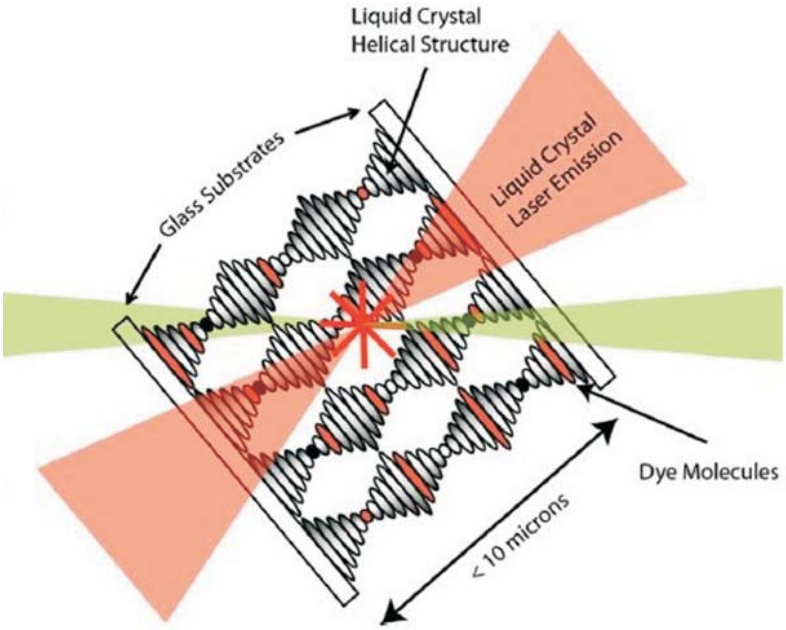
Excitation:

A pulsed optical pump source, tuned to the absorbance of the laser dyes, provides the energy input required. When focussed on the liquid crystal, it produces a laser measuring less than 100 μm in diameter



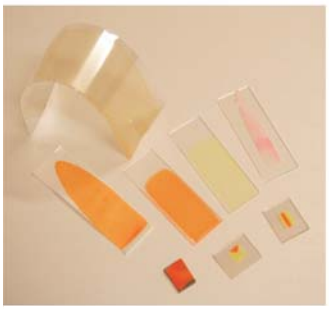
Wavelength tuning

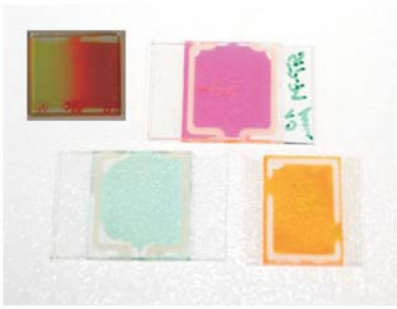
Through manipulation of the pitch of the helical liquid crystal structure (either chemically, electrically or mechanically) wavelength tuning of the emission is possible.



Fabrication

The self-aligning liquid crystal laser mixture is sealed between glass substrates only 10 μm apart, and uses mature fabrication processes common to the liquid crystal display (LCD) industry.





Alternatively, hybrid formulations of liquid crystal and polymer have been developed, enabling paintable or inkjet printable emulsion lasers. These lasing materials are conformable, and can be coated onto arbitrary surfaces (including flexible plastic), requiring no surface preparation or further encapsulation.

Such low-cost materials and manufacturing techniques enable bespoke lasers of custom emission characteristics to be easily fabricated. They also give rise to unique market opportunities such as semi-disposable laser sources.

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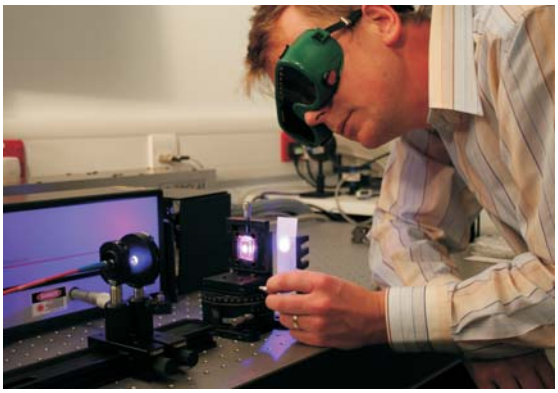
COSMOS lasers

Tunable lasers for laboratory applications

Tuneable lasers are currently used in a wide variety of academic and industrial research facilities. However, current systems are large, complex and highly expensive, making them unsuitable for many users.

COSMOS liquid crystal lasers are continuously tuneable, but within a highly compact and affordable device architecture. They enable the wider adoption of tuneable lasers for a diverse range of research and development applications.



Laboratory-based tuneable laser applications

Reduced complexity, supportive infrastructure, size and cost, combined with improvements in functionality, for applications such as:

- Spectroscopy
- Microscopy
- Photochemistry
- Optical communications
- Displays

Holographic projection

Liquid crystal lasers can be made with variable linewidths, providing low-speckle solutions for both 2D and 3D full-colour holographic projection.

Fluorescence microscopy

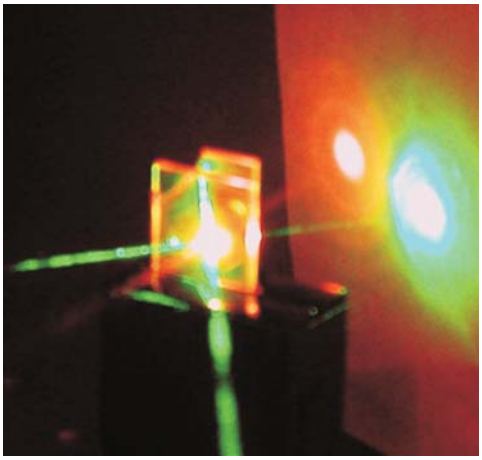
Photo: Wikimedia

Photo: Wikimedia

Liquid crystal lasers can be tuned to precisely match the absorbances of fluorescent tags used in biological and medical research. This enables a wider range of tags and bio-markers to be used, and avoids the use of multiple fixed-wavelength laser sources.

Multi-wavelength emissions also enable simultaneous excitation of several entities within the same sample.

Such features are of particular interest for tools such as confocal microscopy and flow cytometry.



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COSMOS lasers

Tunable lasers for portable medical diagnostics

COSMOS tuneable lasers are highly functional devices, yet compact and low-cost, which could be incorporated into portable or hand-held medical diagnostics systems. Such point-of-care tools could prove life-saving in areas such as the detection and treatment of early-stage malaria, particularly in areas where access to cetralised laser testing facilities is limited.

Obtain sample from patient in the field

Immediate on-site optical analysis

Rapid and accurate diagnosis and treatment

Miniaturisable optical medical techniques include:

- Fluorescence microscopy
- Blood flow cytometry
- Confocal microscopy
- Raman spectroscopy
- Optical coherence tomography (OCT)

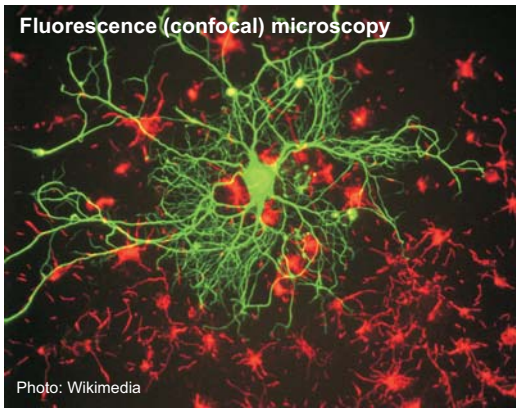
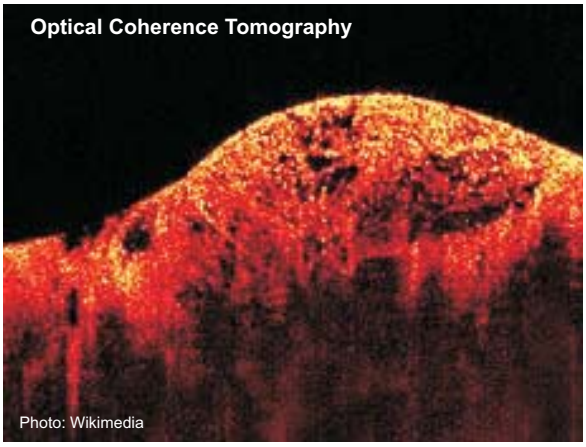


Photo: Wikimedia



Improved functionality

Liquid crystal tuneable lasers offer improved functionality and performance over fixed-wavelength systems:

- Tuneable to arbitrary wavelengths for optimal excitation of bio-markers and fluorophores
- Simultaneous multi-wavelength functionality
- Compact and affordable devices enable point-of-care usage and operation by non-specialists

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