FAR-FIELD IMAGING

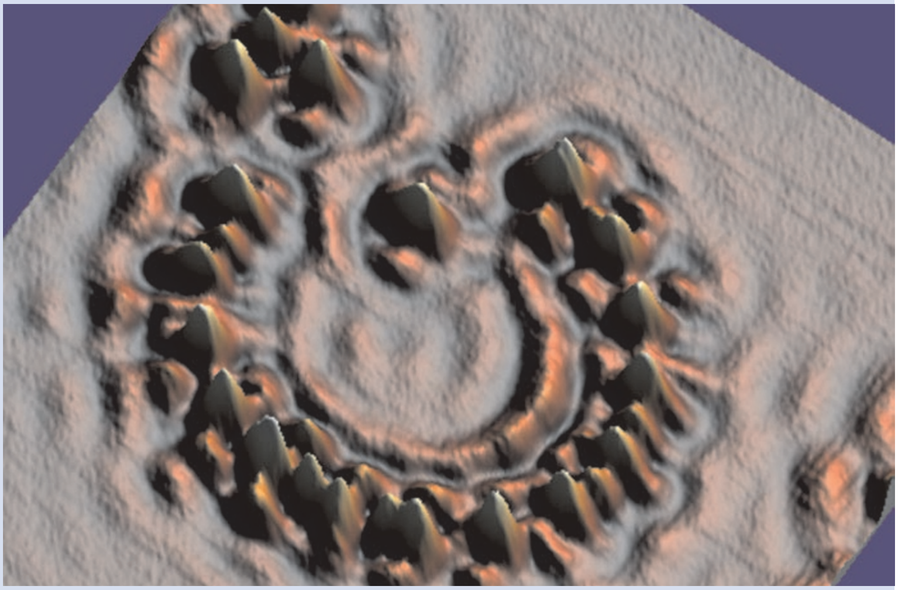
Density of states mapping

A simple far-field technique that can generate quantitative two-dimensional maps of a structure's local electromagnetic density of states (LDOS) could benefit a number of applications. These include enhanced biolabelling and improved optical antennas for harvesting solar energy.

The LDOS is an important quantity that describes the available optical eigenmodes for a photon at a specific location within a material. As can be imagined, it is vital for the understanding and control of many quantum optical phenomena.

Typically, the LDOS is measured by scanning tunnelling microscopy or by scanning near-field optical microscopy operating in illumination mode. However, the images produced by these methods largely depend on the surface cleanliness and the quality of the near-field tip. Moreover, cross-coupling mechanisms between the tip and the structure itself are often neglected in the theoretical analysis of results.

Now, Caijin Huang and colleagues from Université de Bourgogne in France (*Opt. Lett.* **33,** 300–302; 2008) have proposed an experimental method for determining the LDOS. The approach relies on Fourier filtering and integrating the differential scattering cross-section of the material's evanescent modes.



To perform the measurements, the researchers illuminate the structure under test using a 0.65-numerical-aperture lens and collect the scattered light, which contains both propagating and evanescent components, using a 1.45-numerical-aperture lens. The evanescent components are then selected using a beam stop, a pinhole and a photomultiplier tube. Laterally scanning the target structure enables the researchers to record the scattering response for each position so that they can reconstruct a two-dimensional image of the local scattering cross-section of the evanescent modes.

To validate the approach, the team measured the LDOS of two samples — an optical corral comprising 18 identical 50-nm-thick gold nanoparticles, and a 4 μm × 2 μm stadium shape comprising 34 gold nanoparticles.

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SEMICONDUCTOR LASERS

Tuning triumph

Thin-membrane mirrors based on subwavelength gratings are transforming the performance of tunable VCSELs.

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Semiconductor lasers with an emission wavelength that can be electronically tuned are important devices in photonics. They have applications in spectroscopy[1], sensing[2] and communications[3], as well as other areas. An ideal tunable laser combines a large and smooth tuning range with a fast tuning speed and is eagerly sought. Potential applications for such a device include fast wavelength switching in optical communications or investigations of the dynamics of chemical reactions in gases, such as combustion processes.

A design of tunable laser that takes a step towards meeting this goal is reported by Michael Huang and co-workers on page 180 of this issue[4]. Rather than being based on the classical edge-emitting structure, Huang *et al.* devise a laser diode that is a so-called vertical-cavity surface-emitting laser (VCSEL). Originally proposed 30 years ago by the Japanese scientist Kenichi Iga[5], VCSELs have been gaining popularity as a laser source for low-power applications. Fixed-wavelength versions operating in the wavelength range 850–950 nm have been a successful product for more than a decade.

The success of VCSELs is largely due to their unique features, such as longitudinal single-mode operation, a high-speed modulation bandwidth and the ability to