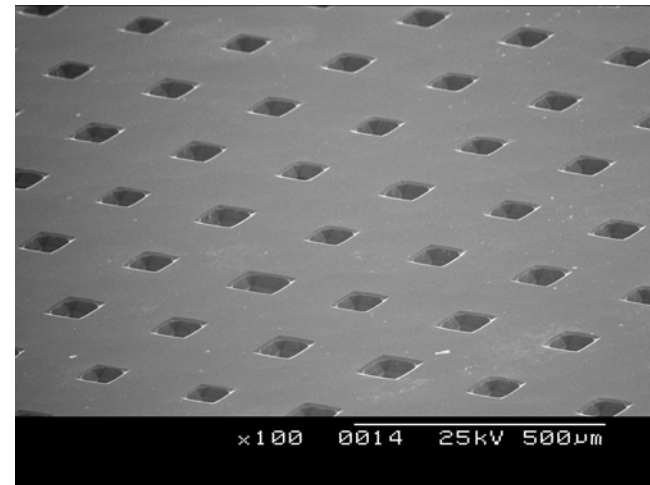
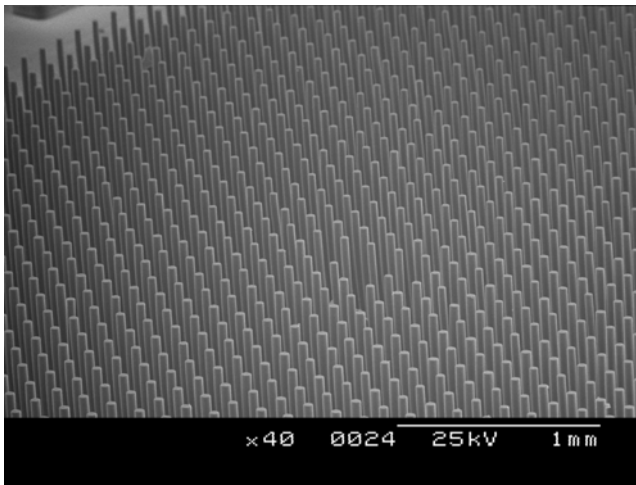


The **Condensed Matter Theory Group** in Durham (made up of Professor Richard Abram, Drs Stuart Brand and Stewart Clark and coworkers) has a wide range of research interests, including the physics of semiconductor materials and quantum structures, molecular solids, liquid crystals, photonic microstructures and related devices. Methods have been developed to study the properties of such systems over a range of length scales from ab initio calculations at the atomic level to the modelling and simulation of devices. At present the **main interests of Professor Abram and Dr Brand concern photonic microstructures with fascinating fundamental properties and a range of potential applications.**

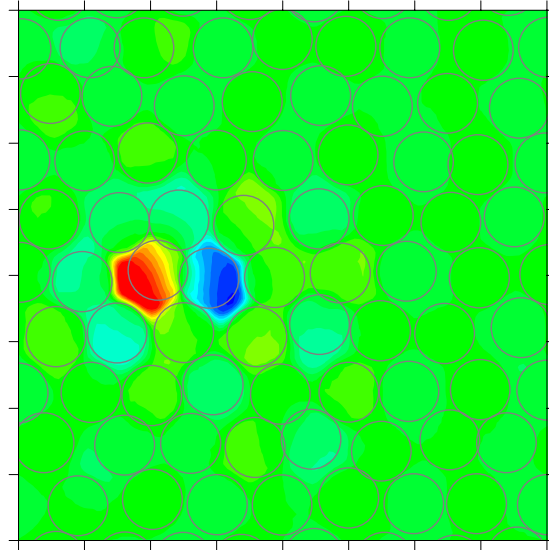
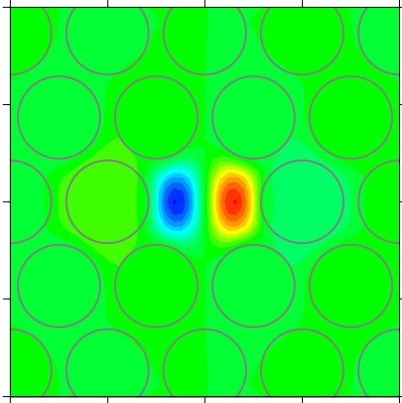
Possible PhD projects on photonic structures include

*Theory of metallic and semiconductor microstructures to control **terahertz frequency radiation** - seen here is a pillar forest (left) and an array of holes (right), both made in Durham, which could be used in a **terahertz microscope with sub-wavelength resolution** for possible medical applications.*

*Other structures will be designed to produce **metamaterials** with a **negative refractive index**.*



Influence of disorder on the optical properties of **photonic crystals**.



Properties of the **light-matter interaction** in optical microcavities containing semiconductor quantum dots or metallic nanoparticles.

The **Bose-Einstein condensation** of exciton-polaritons (resulting from the light-matter interaction) offers the possibility of making a **polariton laser** – a laser that can emit light without population inversion.

