THE AUSTRALIAN NATIONAL UNIVERSITY

Chalcogenide Glasses Reveal the Hole Picture

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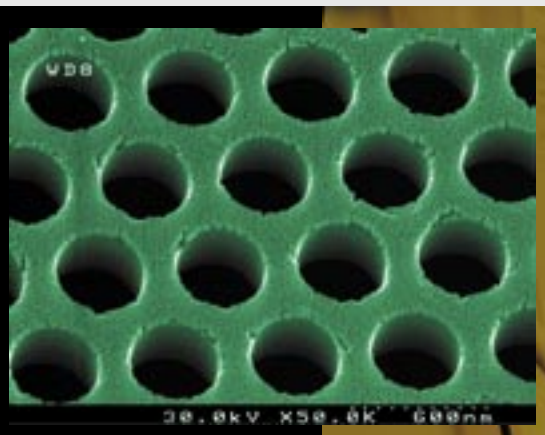
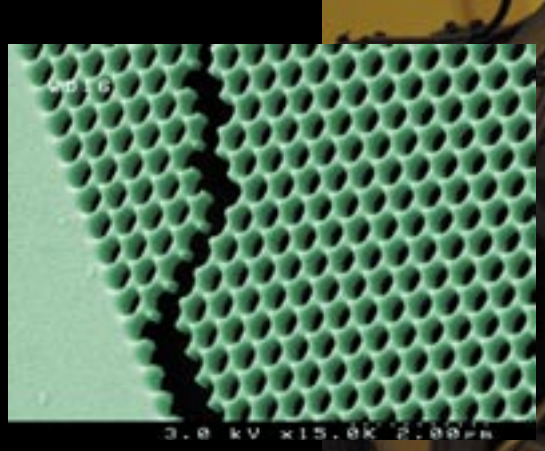
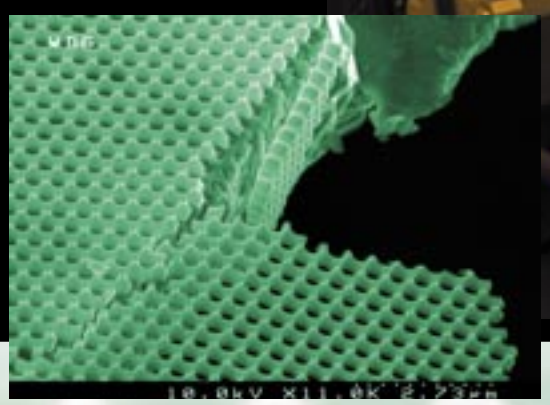
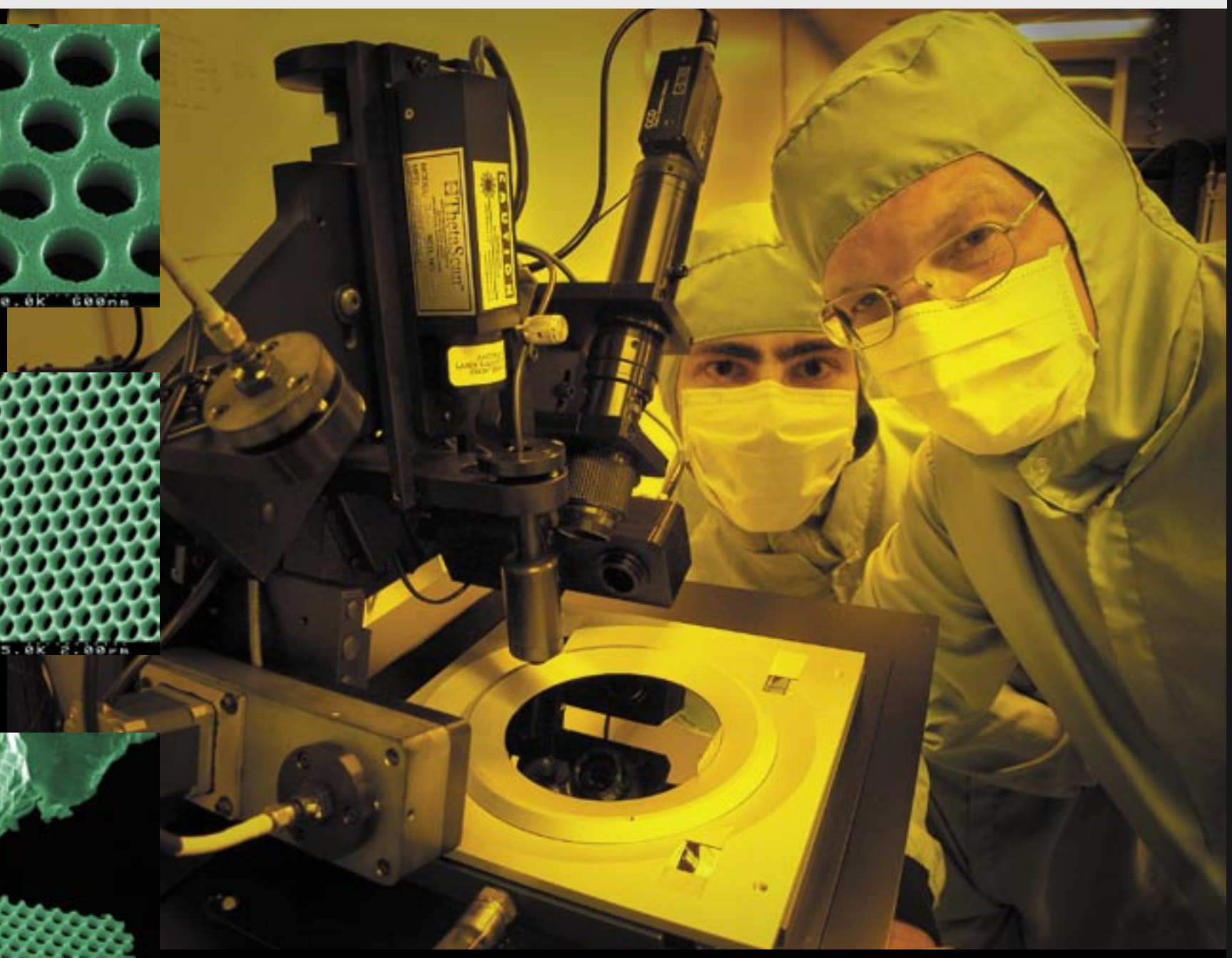






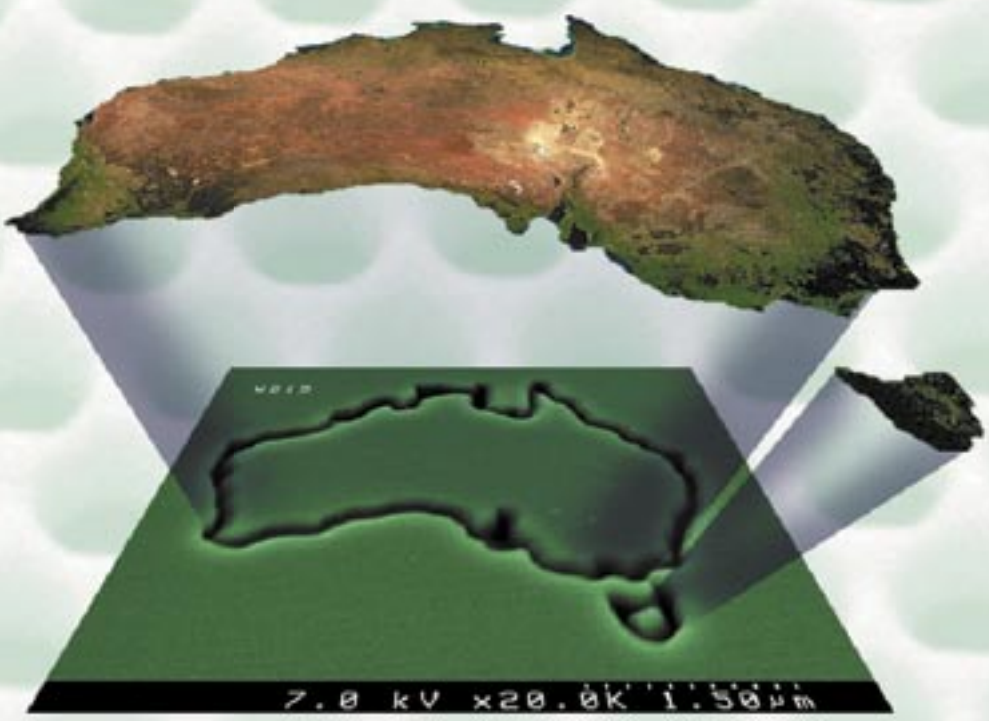


The periodic lattice of atoms in a semiconductor crystal can under some circumstances, interact with electron de Broglie waves to produce forbidden energy gaps and other interesting phenomena. The transistor and thus the entire modern electronics industry is based on this interaction between wave and lattice.

However the underlying physics of wave/lattice interaction isn't just confined to electrons in semiconductors. In more recent years, scientists have begun to study light waves propagating in Photonic Crystals (PhCs) - transparent structures containing a regular lattice of high and low refractive index regions. In principle, these photonic crystals promise an entire suite of optical devices, analogous to those of semiconductor electronics.

The fabrication of such structures has until now, required special techniques such as electron beam lithography and dry etching to achieve the required patterns (periods in the range of 500nm containing holes in the 200-300nm range). To perform well as an optical device the interfaces in these structures must also be very smooth and the pattern regular over many tens of periods both of which are quite difficult to achieve using these conventional techniques.

However, scientists at the ANU, supported by funding from the ARC Centre of Excellence Program, have recently developed an alternative method of fabricating Photonic Crystals using a single step approach. They use a focussed ion beam to mill out holes in high index chalcogenide glass. The air filled holes have a much lower index of refraction than the surrounding glass thus forming a high contrast refractive index lattice. This method produces top quality periodic patterns with very smooth side-walls without the complication of the standard multi-step process. In addition, unlike chemical etch processes, the focussed ion beam mill can generate gratings in almost any material and can even generate three-dimensional "grey-scale" structures.



Demonstrating the versatility of the focussed ion beam mill: a map of Australia only few wavelengths of light across, cut into the surface of glass