newsbreaks

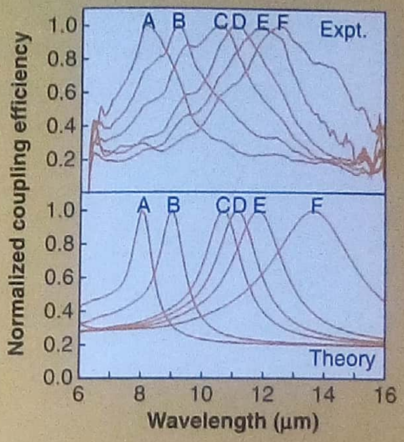
Feroelectric domain patterns are directly written into lithium niobate

Another approach to fabricating polings with short periods in lithium niobate ($LiNbO_3$) for use as nonlinear optical crystals has been demonstrated by researchers at Lehigh University (Bethlehem, PA). The Lehigh University group has developed a new technique in which ferroelectric-domain patterns are directly written onto a $LiNbO_3$ wafer. In this technique, a field smaller than the one usually required for domain inversion is applied to the sample and a tightly focused 488-nm laser beam defines the positions at which the inversion takes place.

The origin of the effect is under investigation, but it is clear already that a space-charge field induced by the strongly inhomogeneous illumination and photo-ionization plays a major role in the process. The researchers found that the best results and smallest features can be achieved when the process is divided into two phases: domain nucleation and laser-guided growth of the domain. This crucial division of procession steps allows accurate control in the direct-writing method and is not possible in currently used methods. The patterns produced so far exhibit feature sizes down to 1 µm that appear to be limited only by the diffraction-limited spot size of the writing laser. *Contact Volkmar Dierolf at* vod2@lehigh.edu.

Quantum-grid IR spectrometer forms pixel of focal-plane array

The field of imaging spectrometry may soon grow richer in the IR, if a single-pixel IR-spectrometer prototype developed by researchers at the U.S. Army Research Laboratory (Adelphi, MD) and Polytechnic University (Brooklyn, NY) is replicated into a 2-D focal-plane array. The pixel is a set of detectors called quantum-grid infrared photodetectors (QDIPs).



A grid is fabricated into a structure of aluminum gallium arsenide–based multiple quantum wells; metal strips on top of the grid scatter light into the wells. Each metal strip has a different width, selecting the peak detection wavelength of the structure beneath the grid. A prototype pixel with six QDIPs (A through E in figure) shows a peak coupling efficiency at a different wavelength for each stripe (top, measured; bottom, theoretical), spanning a broad band. "We are planning to rearrange the grid pattern into the shape of a daisy so that the center can be used for indium bonding, and the petals serve as multiprong optical antennas," says Kwong-Kit Choi, one of the researchers. "With this geometry, we are going to make the pixels as small as 18 × 18 µm in a focal-plane array." *Contact Choi at* kchoi@arl.army.mil.

Surface poling in lithium niobate waveguide creates efficient wavelength conversion

Used with red- or IR-emitting laser diodes, nonlinear crystals for frequency-doubling can result in a small blue-emitting laser that is a viable alternative to gallium nitride–based laser diodes. Periodically poled lithium niobate (PPLN) is a type of nonlinear crystal well known for this purpose. Researchers at the University of Southampton (Southampton, England) are using surface-domain inversion to create short-period (2.47-µm) periodic polings in waveguide versions of these crystals, resulting in efficient first-order quasi-phase-matched wavelength conversion.

Room-temperature photolithographic poling with an intentional "overpoling" step leaves small inverted domains under the photoresist-covered areas that maintain their original polarization states even when the rest of the volume has merged into one domain. An array of 12 waveguides separated by 100 µm and varying in width from 1.5 to 8 µm was fabricated and then poled. For a 825.2-nm pump wavelength (provided by a Ti:sapphire laser), the prototype 2-cm-long PPLN waveguide produced a second-harmonic (412.6-nm) power of 6 mW in the fundamental waveguide mode at a conversion efficiency of 7.4%, or a normalized conversion efficiency of 22.8%/W-cm^2. Optimized devices will perform at a higher efficiency. *Contact Alessandro Busacca at* busacca@unipa.it.