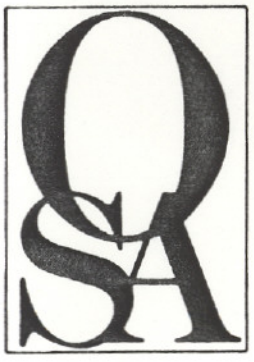

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WH 8:30am MORNING
Fairmont Regency 1

Optical Materials
Alastair M. Glass, *AT&T Bell Laboratories, Presider*

8:30am

WH1 Stimulated emission and lasing studies of wide gap II–VI compounds using optical excitation

X. H. Yang, J. Hays, W. Shan, and J. J. Song
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Stimulated emission and lasing effects of bulk ZnSe samples, grown by physical vapor-phase transport technique and MBE epilayers on GaAs substrates were investigated (using a 10-ns pulsed laser) in the frequency as well as in the time domain. For lasing studies, a laser cavity was formed by cleaving the sample's two parallel facets with the cavity lengths of a few hundred microns. The cleaved edges were not subjected to reflective coatings. The lasing threshold densities were found to be surprisingly low; ~7 kW/cm^2 for a sample with a cavity length of 300 μm. The longitudinal modes of the lasers were clearly resolved. Stimulated emission at both 10 and 300 K was observed. The stimulated emission was evidenced by the spectral narrowing of the emission peak, the highly superlinear dependence of the output signal on the pumping power density, and the narrowing of the temporal profile under high excitation. The gain values were measured by the variable excitation length method. The effect of the pumping photon energy on the stimulated emission at room temperature was investigated.

A comparison between the bulk and MBE samples is made and the physical mechanism involved is discussed.

8:45am

WH2 Noise performance of photorefractive crystal holograms

Q. Wang Song, Partha P. Banerjee, and Jaw-Jei Liu
Syracuse University, Department of Electrical Engineering, Syracuse, New York 13244

We analyze the temporal and spatial nature of the diffracted light from a photorefractive volume hologram under the influence of electronic noise in the material. Because of this noise, the holographic grating within the crystal is not strictly periodic; in other words, it has random fluctuations in both amplitude and period. Gaussian beam illumination at the nominal Bragg angle is assumed. The reason for this choice is that we can now evaluate not only the temporal statistics in the diffracted light, but also its spatial randomness. This quantitative evaluation achieved through defining a system transfer function that relates the output diffracted light to the input in the spatial frequency domain. For light nominally incident at the Bragg angle, this transfer function may be derived by Fourier transforming the paraxial wave equation in the presence of interaction terms. Estimation of spatial randomness is not possible to calculate assuming plane wave illumination since one cannot monitor transverse fluctuations along its wavefront. By using first-order approximation, the temporal and spatial noise ratios are obtained. Their dependence on reading time, reading beam intensity, grating spacing, and temperature are predicted.

9:00am

WH3 Self-trapped exciton enhanced photostructural transformation in AsSe fiber glass

A. W. Schmid, M. Kim, K. Cerqua, and W. D. LaCourse
University of Rochester, Laser Energetics Laboratory, 250 E. River Road, Rochester, New York 14623

Arsenic chalcogenide glasses for IR fiber and data storage uses exhibit photoinduced structural transformations when irradiated by below-band-gap light. We demonstrate that these transformations are enhanced by irradiating at a self-trapped exciton (STE) resonance wavelength. Rayleigh and Raman signals show that STE decay leads to instabilities among metastable structural states in bulk glass. With time constants of the order of seconds, these instabilities may switch abruptly into states of increased order. By varying the relative concentration in these binary compounds, we control the availability of the initial STE forming state. These measurements provide evidence that photoinduced structural transformations in arsenic selenides occur at 1–5 W/cm^2 irradiation levels.

9:15am

WH4 Effects of operator ordering in effective-mass Hamiltonian on transition energies in semiconductor quantum wells

Mohammad Mojahedie and Marek Osinski
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It has been recognized that use of the effective mass theory for abrupt interfaces between different materials suffers from ambiguity in kinetic-energy operator ordering, caused by nonvanishing commutator of the momentum operator and the position-dependent effective mass. This leads to nonuniqueness of the Hamiltonian, which in its general form can be written as a one-parameter family of operators.[1] The matching conditions for the envelope wave function and its derivative at the interfaces are also parametrized.[1] Recently, Fu and Chao reported[2] that experimentally observable interband transition energies are not sensitive to the effective-mass operator ordering. In this paper, we demonstrate that optical transition energies do vary substantially with ordering. Specifically, we have analyzed GaAs/AlGaAs quantum wells using the transfer matrix technique.[2] We have investigated the effects of quantum well parameters, such as subband index, thicknesses of both constituent materials, and barrier height (composition) on the shifts of subband-edge energy, between the two extreme cases of operator ordering. Calculated energy levels are more sensitive to ordering for higher subbands and for decreasing well thickness. Increasing the barrier height or thickness in coupled quantum wells will also result in a larger shift of subband-edge energies. Comparison with available data allows us to choose the ordering that provides the best fit to experiment.

References

1. G. T. Einevoll, P. C. Hemmer, and J. Thomsen, Phys. Rev. B 42, 3485 (1990).
2. Y. Fu and K. A. Chao, Phys. Rev. B 40, 8439 (1989).

9:30am

WH5 Nonlinear optical characteristics of two-wave mixing in InP:Fe photorefractive crystals

Yang Zhao, Qingfeng Tang, and Zhaolin Li
Wayne State University, Department of Electrical & Computer Engineering, Detroit, Michigan 48202

InP:Fe photorefractive crystals are attractive materials for optical information processing due to their fast response time and relatively high nonlinearity. In this work, we investigate two-wave mixing in these crystals as a function of light intensity, beam intensity ratio, and external electric field intensity. The crystal used in our experiments was 2.2 × 2.5 × 3 mm with incident direction <110> normal to the 2.5 × 3-mm face. The laser wavelength is 1.06 μm. In addition to the energy transfer between the beams, we observed the beam path deflection effect in the crystal in our experiments. The amount of the path deflection depends on the input intensity levels. A change in the angle between the interaction beams by 2.4° was observed without external electric field on the crystal. In addition, we observed the energy transfer from the pump to signal with pump-to-signal intensity ratios >>1.

We also found that the nonlinear effects of the crystal depends on the exposure time of the crystal to the laser and illumination light.

9:45am

WH6 Beam diameter threshold for photoinduced polarization conversion in $LiNbO_3$:Fe

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Photoinduced polarization conversion is a form of optical damage in $LiNbO_3$ waveguide devices.[1] In an attempt to better understand this phenomenon, we have studied the effect in bulk $LiNbO_3$:Fe. In this work, we have observed nearly complete ordinary-to-extraordinary polarization conversion in $LiNbO_3$:Fe for input ordinary beam diameters greater than ~200 μm and no polarization conversion for beam diameters less