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INFRARED RUGATES BY MOLECULAR BEAM EPITAXY. M. Rona, Arthur D. Little, Inc., Cambridge MA 02140, USA.

Rugates are optical structures that have a sinusoidal index of refraction (harmonic gradient-index field). As their discrete high/low index filter counterparts, they can be used as narrow rejection band filters. However, since rugates do not have abrupt interfaces, they tend to have a smaller absorption, hence deliver a higher in-band reflectivity. The absence of sharp interfaces makes rugates even more desirable for high-energy narrowband reflectors. In this application, the lack of a sharp interface at the maximum internal standing wave electric field results in higher breakdown strengths.

Our method involves fabricating rugates, with molecular beam epitaxy [1], on GaAs wafers as an $Al(x)Ga(1-x)As$ single-crystal film in which x, the alloying ratio, changes in a periodic fashion between $0 < x < 0.5$ [2]. The single-crystal material improves the rugate performance even further by eliminating the enhanced optical absorption associated with the grain boundaries. Salient features of our single-crystal rugate fabrication program, including the process control system and methodology and some representative results, are shown [3].

References: [1] Rona M. and Sullivan P. W. (1982) *Laser Induced Damage in Optical Materials: 1982 Proceedings of the Symposium (NBS-SP-69)* (H. E. Bennett et al., eds.), pp. 234–242. [2] Rona M. (1989) *Proceedings of the Topical Meeting in High Power Laser Optical Components,* 30–31 October 1989, Unclassified Papers, Naval Weapons Center NWC-TP 7080, part 1 (J. L. Stanford, ed.), pp. 431–436. [3] Rona M., *Report to the Materials Director Wright Laboratory,* Air Force Systems Command, Wright Patterson Air Force Base, Ohio 45433-6533, Report No. WL-TR-91-4144.

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PLASMA, MAGNETIC, AND ELECTROMAGNETIC MEASUREMENTS AT NONMAGNETIC BODIES. C. T. Russell and J. G. Luhmann, Institute of Geophysics and Planetary Physics, University of California, Los Angeles CA 90024-1567, USA.

The need to explore the magnetospheres of the Earth and the giant planets is widely recognized and is an integral part of our planetary exploration program. The equal need to explore the plasma, magnetic, and electromagnetic environments of the nonmagnetic bodies is not so widely appreciated. The previous, albeit incomplete, magnetic and electric field measurements at Venus, Mars, and comets have proven critical to our understanding of their atmospheres and ionospheres in areas ranging from planetary lightning to solar wind scavenging and accretion. In the cases of Venus and Mars, the ionospheres can provide communication paths over the horizon for low-altitude probes and landers, but we know little about their lower boundaries. The expected varying magnetic fields below these planetary ionospheres penetrates the planetary crusts and can be used to sound the electrical conductivity and hence the thermal profiles of the interiors. However, we have no knowledge of the levels of such fields, let alone their morphology. Finally, we note that the absence of an atmosphere and an ionosphere does not make an object any less interesting for the purposes of electromagnetic exploration. Even weak remanent magnetism such as that found on the Moon during the Apollo program provides insight into the present and past states of planetary interiors. We have very intriguing data from our space probes during times of both close and distant passages of asteroids that suggest they may have coherent magnetization. If true, this observation will put important constraints on how the asteroids formed and have evolved. Our planetary exploration program must exploit its full range of exploration tools if it is to characterize the bodies of the solar system thoroughly. We should especially take advantage of those techniques that are proven and require low mass, low power, and low telemetry rates to undertake.

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A COMPACT IMAGING DETECTOR OF POLARIZATION AND SPECTRAL CONTENT. D. M. Rust, A. Kumar, and K. E. Thompson, Applied Physics Laboratory, The Johns Hopkins University, Johns Hopkins Road, Laurel MD 20723, USA.

A new type of image detector will simultaneously analyze the polarization of light at all picture elements in a scene. The Integrated Dual Imaging Detector (IDID) consists of a polarizing beam splitter bonded to a charge-coupled device (CCD), with signal-analysis circuitry and analog-to-digital converters, all integrated on a silicon chip. The polarizing beam splitter can be either a Ronchi ruling, or an array of cylindrical lenslets, bonded to a birefringent wafer. The wafer, in turn, is bonded to the CCD so that light in the two orthogonal planes of polarization falls on adjacent pairs of pixels. The use of a high-index birefringent material, e.g., rutile, allows the IDID to operate at f-numbers as high as f/3.5.

Without an auxiliary processor, the IDID will output the polarization map of a scene with about 1% precision. With an auxiliary processor, it should be capable of $1:10^4$ polarization discrimination. The IDID is intended to simplify the design and operation of imaging polarimeters and spectroscopic imagers used, for example, in planetary, atmospheric and solar research. Innovations in the IDID include (1) two interleaved 512×1024-pixel imaging arrays (one for each polarization plane), (2) large dynamic range (well depth of 10^6 electrons per pixel), (3) simultaneous read-out of both images at 10 million pixels per second each, (4) on-chip analog signal processing to produce polarization maps in real time, and (5) on-chip 10-bit A/D conversion. When used with a lithium-niobate Fabry-Perot etalon or other color filter that can encode spectral information as polarization, the IDID can collect and analyze simultaneous images at two wavelengths. Precise photometric analysis of molecular or atomic concentrations in the atmosphere is one suggested application.

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DIGITAL IMAGE COMPRESSION USING ARTIFICIAL NEURAL NETWORKS. M. Serra-Ricart[1], Ll. Garrido[2,3], V. Gaitan[2], and A. Aloy[4], [1]Instituto de Astrofisica de Canarias, E-38200 La Laguna (Tenerife), Spain, [2]Departament d'Estructura i Constituens de la Materia, Universitat de Barcelona, Diagonal 647, E-08028 Barcelona, Spain, [3]Institut de Fisica d'Altes Energies, Universitat Autònoma de Barcelona, E-08193 Bellaterra (Barcelona), Spain, [4]Digital Equipment Enterprise Espana SA., Provenza, 204-208, 08036 Barcelona, Spain.

The problem of storing, transmitting, and manipulating digital images is considered. Because of the file sizes involved, large amounts of digitized image information are becoming common in