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<sub>x</sub>Ga<sub>1-x</sub>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:

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 lenses, 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 100% 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 x 1024-pixel imaging arrays (one for each polarization plane), (2) large dynamic range (well depth of 10<sup>6</sup> 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.
modern projects. Transmitting images will always consume large amounts of bandwidth, and storing images will always require special devices. Our goal is to describe an image compression transform coder based on artificial neural networks techniques (hereafter Neural Network Compression Transform Coder or NNCTC). Like all generic image compression transform coders, the NNCTC embodies a three-step algorithm: invertible transformation to the image (transform), lossy quantization (quantize), and entropy coding (remove redundancy). Efficient algorithms have already been developed to achieve the two last steps, quantize and remove redundancy [4]. The NNCTC offers an alternative invertible transformation based on neural network analysis [3].

A comparison of the compression results obtained from digital astronomical images by the NNCTC and the method used in the compression of the digitized sky survey from the Space Telescope Science Institute based on the H-transform [3] is performed in order to assess the reliability of the NNCTC.

Artificial neural network techniques are based on the dot-product calculation, which is very simple to perform in hardware [4]. It is in this sense that the NNCTC can be useful when high compression and/or decompression rates are required (e.g., space applications, remote observing, remote database access).


PROTOTYPE BACKSCATTER MOSSBAUER SPECTROMETER FOR MESURment OF MARTIAN SURFACE MINERALOGY. T. D. Shelfer1, R. V. Morris1, D. G. Agresti2, T. Nguyen3, E. L. Wills4, and M. H. Shen5. 1Code SN4, NASA Johnson Space Center, Houston TX 77058, USA, 2Physics Department, University of Alabama at Birmingham, Birmingham AL 35294, USA, 3Lockheed Engineering and Sciences Co., Houston TX 77058, USA.

We have designed and successfully tested a prototype of a backscatter Mössbauer spectrometer (BaMS) targeted for use on the martian surface to (1) determine oxidation states of iron and (2) identify and determine relative abundances of iron-bearing mineralogies. No sample preparation is required to perform measurements; it is only necessary to bring sample and instrument into physical contact. The prototype meets our projected specifications for a flight instrument in terms of mass (<500 g), power (<2 W), and volume (<300 cm³).

A Mössbauer spectrometer on the martian surface would provide a wide variety of information about the current state of the martian surface:

1. Oxidation state: Iron Mössbauer spectroscopy (FeMS) can determine the distribution of iron among its oxidation states. Is soil oxidized relative to rocks?

2. Mineralogy: FeMS can identify iron-bearing mineralogies (e.g., olivine, pyroxene, magnetite, hematite, ilmenite, clay, and amorphous phases) and their relative abundances. FeMS is not blind to opaque phases (e.g., ilmenite and magnetite), as are visible and near-IR spectroscopy.

3. Magnetic properties: FeMS can distinguish between magnetic and magnetite, which are putative mineralogies to explain the magnetic nature of martian soil.

4. Water: FeMS can distinguish between anhydrous phases such as hematite, olivine, pyroxene, and hydrous phases such as clay, ferrihydrite, goethite, and lepidocrocite. What are the relative proportions of hydrous and anhydrous iron-bearing mineralogies?

In summary, a BaMS instrument on MUESR would provide a very high return of scientific information about the martian surface (with no sample preparation) and would place a very low resource demand (weight, power, mass, data rate) on spacecraft and lander. Our BaMS instrument can be flight-qualified within two years and is also suitable for lander missions to the Moon, comets, and asteroids.


THE BACKGROUNDS DATA CENTER. W. A. Snyder1, H. Gursky1, H. M. Heckathorn2, R. L. Lucke1, S. L. Berg2, E. G. Dombrowski3, and R. A. Kessel3, 1Code 7604, Naval Research Laboratory, Washington DC 20375-5352, USA, 2Computational Physics, Inc., Suite 600, 2750 Prosperity Avenue, Fairfax VA 22031, USA, 3Sachs-Freeman Associates, 1401 McCormick Drive, Landover MD 20785, USA.

The Strategic Defense Initiative Organization (SDIO) has created data centers for midcourse, plumes, and backgrounds