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This presentation will detail an application of these black surfaces to the Clementine star-tracker navigational system, which will be launched in early 1994 to examine the Moon, en route to intercept an asteroid. Rugged black surfaces with Lambertian BRDF $<10^{-2}$ $srad^{-1}$ are critical for suppressing stray light in the star-tracker optical train. Previously available materials spall under launch vibrations to contaminate mirrors and lenses. Microtextured aluminum is nearly as dark, but much less fragile. It is made by differential ion beam sputtering, which generates light-trapping pores and cones slightly smaller than the wavelength to be absorbed. This leaves a sturdy but light-absorbing surface that can survive challenging conditions without generating debris or contaminants. Both seeded ion beams and plasma immersion (from ECR plasmas) extraction can produce these microscopic textures without fragile interfaces. Process parameters control feature size, spacing, and optical effects (THR, BRDF). Both broad and narrow absorption bands can be engineered with tuning for specific wavelengths and applications. Examples will be presented characterized by FTIR in reflection mode. Textured metal blacks are also ideal for blackbody calibrators (0.95 normal emissivity), heat rejection, and enhanced nucleate boiling.

N93-28786

NEW TECHNOLOGIES FOR UV DETECTORS. C. L. Joseph, Space Astronomy Laboratory, University of Wisconsin, 1150 University Avenue, Madison WI 53706, USA.

Several technologies are currently being developed, leading to substantial improvements in the performance of UV detectors or significant reductions in power or weight. Four technologies discussed are (1) thin-film coatings to enhance the UV sensitivity of CCDs, (2) highly innovative magnet assemblies that dramatically reduce weight and result in virtually no external flux, (3) new techniques for curving microchannel plates (MCPs) so that single plates can be used to prevent ion feedback and present highly localized charge clouds to an anode structure, and (4) high-performance alternatives to glass-based MCPs. In item (2), for example, very robust magnets are made out of rare earth materials such as samarium cobalt, and cladding magnets are employed to prevent flux from escaping from the detector into the external environment. These new ultralight magnet assemblies are able to create strong, exceptionally uniform magnetic fields for image intensification and focusing of photoelectrons. The principle advantage of such detectors is the quantum efficiencies of 70–80% obtained throughout ultraviolet wavelengths (900–2000 Å), the highest of any device.

Despite the improvements achieved under item (3), high-performance alternatives to conventional glass-based MCPs potentially offer three distinct new advantages that include (1) a 30–100-fold improvement in dynamic range resulting in correspondingly higher signal-to-noise ratios, (2) the use of pure dielectric and semiconductor materials that will not outgas contaminants that eventually destroy photocathodes, and (3) channels that have constant spacing providing long-ranged order since the plates are made using photolithography techniques from the semiconductor industry. The manufacturers of these advanced-technology MCPs, however, are a couple of years away from actually producing a functioning image intensifier.

In contrast to the use of CCDs for optical, groundbased observations, there is no single detector technology in the ultraviolet that dominates or is as universally suitable for all applications. Thus, we address several technological problems, recent advances, and the impact that these new enabling technologies represent for UV applications.

N93-28787

LIGHTWEIGHT MODULAR INSTRUMENTATION FOR PLANETARY APPLICATIONS. P. B. Joshi, Physical Sciences Inc., 20 New England Business Center, Andover MA 01810, USA.

Physical Sciences Inc. is currently developing under SDIO sponsorship an instrumentation suite for monitoring the spacecraft environment and for accurately measuring the degradation of space materials in LEO. The instrumentation, called SAMMES (Space Active Modular Materials ExperimentS), features compact (~6-in

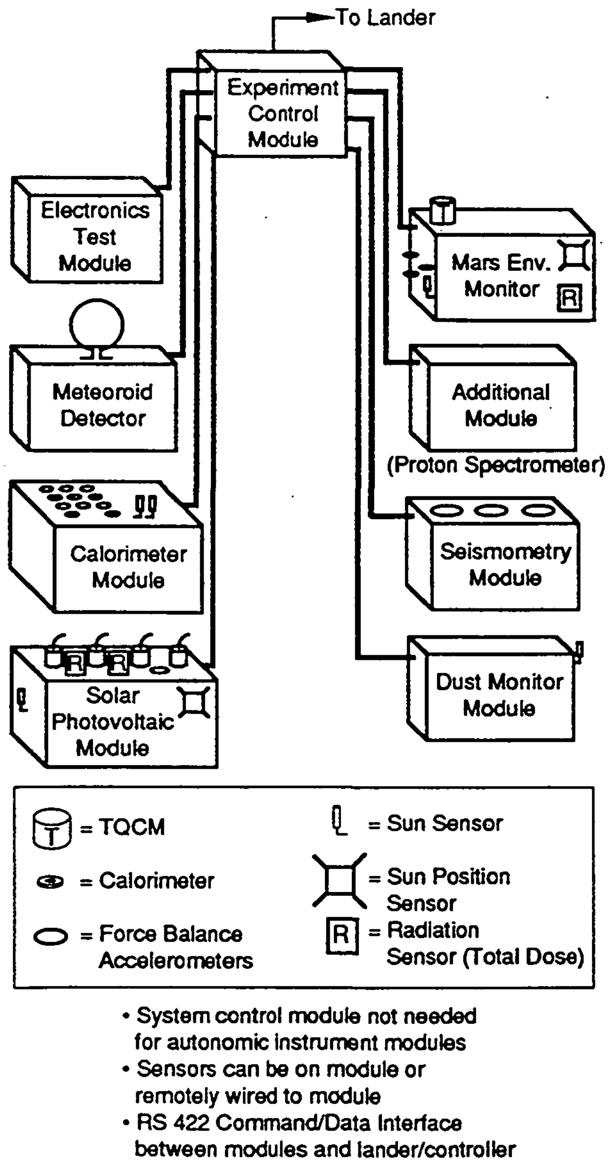

Fig. 1. Sensor/instrumentation concept for lunar/martian application.

cube), lightweight (~2.5 kg) modules incorporating a variety of sensors and low-power (~5 W) processing electronics. The LEO Environment Monitor Module (EMM) sensor complement consists of two passively called Quartz Crystal Microbalances and three calorimeters for contaminant detection/characterization, three actinometers for measuring AO flux, two RADFETs for total dose radiation measurement, a Sun position sensor, and a solar irradiance sensor. The EMM is designed as a remote terminal for MIL-STD-1553B communication with an experiment bus controller and for independent operation of its sensors. The present design can be modified to be fully autonomous, with module-based mass memory, onboard data processing, and software upload capability.

The SAMMES architecture concept can be extended to instrumentation for planetary exploration, both on spacecraft and *in situ*. The operating environment for planetary application will be substantially different, with temperature extremes and harsh solar wind and cosmic ray flux on lunar surfaces and temperature extremes and high winds on venusian and martian surfaces. Moreover, instruments for surface deployment, which will be packaged in a small lander/rover (as in MESUR, for example), must be extremely compact with ultralow power and weight. With these requirements in mind, we have extended the SAMMES concept to a sensor/instrumentation scheme for the lunar and martian surface environment, as illustrated in Fig. 1.

N93-28788

OPTICAL TECHNOLOGIES FOR UV REMOTE SENSING INSTRUMENTS.

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Over the last decade significant advances in technology have made possible development of instruments with substantially improved efficiency in the UV spectral region. In the area of optical coatings and materials, we discuss the importance of recent developments in chemical vapor deposited (CVD) silicon carbide (SiC) mirrors, SiC films, and multilayer coatings in the context of ultraviolet instrumentation design. For example, the development of chemically vapor deposited (CVD) silicon carbide (SiC) mirrors, with high ultraviolet (UV) reflectance and low scatter surfaces, provides the opportunity to extend higher spectral/spatial resolution capability into the 50-nm region. Optical coatings for normal incidence diffraction gratings are particularly important for the evolution of efficient extreme ultraviolet (EUV) spectrographs. SiC films are important for optimizing the spectrograph performance in the 90-nm spectral region.

Diffraction grating technology has always played a pivotal role in the development of spectroscopic instrumentation for ultraviolet space flight instrumentation. An essential element in the successful diffraction grating development program is the ability to quantitatively evaluate the performance of test diffraction gratings in the early stages of the instrument development program. The Diffraction Grating Evaluation Facility (DGEF) at Goddard Space Flight Center was established to evaluate the performance of new technology diffraction gratings and other optical components for future spaceflight instrumentation especially in the vacuum ultraviolet. DGEF is a unique, world-class, extremely versatile facility with enormous evacuable optical set-up volume allowing mirrors and gratings to be evaluated in their design configurations with respect to design specifications, manufacturer's data, and optical analytical results.

We will discuss the performance evaluation of the flight optical components for the Solar Ultraviolet Measurements of Emitted Radiation (SUMER) instrument, a spectroscopic instrument to fly aboard the Solar and Heliospheric Observatory (SOHO) mission, designed to study dynamic processes, temperatures, and densities in the plasma of the upper atmosphere of the Sun in the wavelength range from 50 nm to 160 nm. The optical components were evaluated for imaging and scatter in the UV. We will also review the performance evaluation of SOHO/CDS (Coronal Diagnostic Spectrometer) flight gratings tested for spectral resolution and scatter in the DGEF and present preliminary results on resolution and scatter testing of Space Telescope Imaging Spectrograph (STIS) technology development diffraction gratings.

N93-28789

MULTISCALE MORPHOLOGICAL FILTERING FOR ANALYSIS OF NOISY AND COMPLEX IMAGES.

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Images acquired with passive sensing techniques suffer from illumination variations and poor local contrasts that create major difficulties in interpretation and identification tasks. On the other hand, images acquired with active sensing techniques based on monochromatic illumination are degraded with speckle noise. Mathematical morphology offers elegant techniques to handle a wide range of image degradation problems. Unlike linear filters, morphological filters do not blur the edges and hence maintain higher image resolution. Their rich mathematical framework facilitates the design and analysis of these filters as well as their hardware implementation. Morphological filters are easier to implement and are more cost effective and efficient than several conventional linear filters. Morphological filters to remove speckle noise while maintaining high resolution and preserving thin image regions that are particularly vulnerable to speckle noise [1] have been developed and applied to SAR imagery. These filters used combination of linear (one-dimensional) structuring elements in different (typically four) orientations (the median operators by Maragos [2]). Although this approach preserves more details than the simple morphological filters using two-dimensional structuring elements, the limited orientations of one-dimensional elements approximate the fine details of the region boundaries. A more robust filter designed recently overcomes the limitation of the fixed orientations. This filter uses a combination of concave and convex structuring elements. Morphological operators are also useful in extracting features from visible and infrared imagery. A multiresolution image pyramid obtained with successive filtering and a subsampling process aids in the removal of the illumination variations and enhances local contrasts. A morphology-based interpolation scheme has also been introduced to reduce intensity discontinuities created in any morphological filtering task. The generality of morphological filtering techniques in extracting information from a wide variety of images obtained with active and passive sensing techniques will be discussed. Such techniques are particularly useful in obtaining more