



## Physical Sciences

### Spectroscopic Chemical Analysis Methods and Apparatus

Ames Research Center, Moffett Field, California

This invention relates to non-contact spectroscopic methods and apparatus for performing chemical analysis and the ideal wavelengths and sources needed for this analysis. It employs deep ultraviolet (200- to 300-nm spectral range) electron-beam-pumped wide bandgap semiconductor lasers, incoherent wide bandgap semiconductor light-emitting devices, and hollow cathode metal ion lasers.

Three achieved goals for this innovation are to reduce the size (under 20 L), reduce the weight [under 100 lb ( $\approx 45$  kg)], and reduce the power consumption (under 100 W). This method can be used in microscope or macroscope to provide measurement of Raman and/or native fluorescence emission spectra either by point-by-point measurement, or by global

imaging of emissions within specific ultraviolet spectral bands. In other embodiments, the method can be used in analytical instruments such as capillary electrophoresis, capillary electrochromatography, high-performance liquid chromatography, flow cytometry, and related instruments for detection and identification of unknown analytes using a combination of native fluorescence and/or Raman spectroscopic methods.

This design provides an electron-beam-pumped semiconductor radiation-producing method, or source, that can emit at a wavelength (or wavelengths) below 300 nm, e.g. in the deep ultraviolet between about 200 and 300 nm, and more preferably less than 260 nm. In some variations, the method is to produce incoherent radiation, while in other implementa-

tions it produces laser radiation. In some variations, this object is achieved by using an AlGaN emission medium, while in other implementations a diamond emission medium may be used.

This instrument irradiates a sample with deep UV radiation, and then uses an improved filter for separating wavelengths to be detected. This provides a multi-stage analysis of the sample. To avoid the difficulties related to producing deep UV semiconductor sources, a pumping approach has been developed that uses ballistic electron beam injection directly into the active region of a wide bandgap semiconductor material.

*This work was done by William F. Hug and Ray D. Reid of Photon Systems, Inc. for Ames Research Center. Further information is contained in a TSP (see page 1). ARC-15298-1*

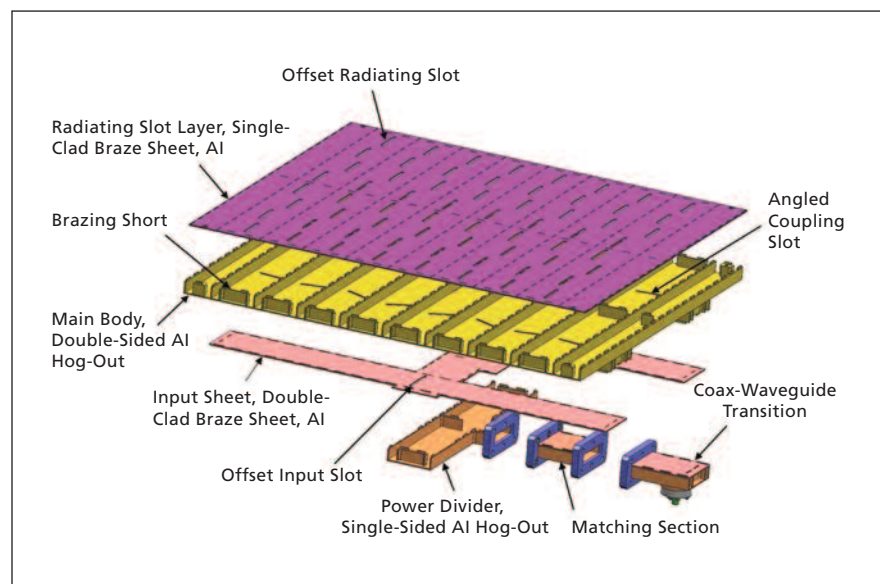
### Low Average Sidelobe Slot Array Antennas for Radiometer Applications

Slot arrays are used in radar, remote sensing, and communications applications.

NASA's Jet Propulsion Laboratory, Pasadena, California

In radiometer applications, it is required to design antennas that meet low average sidelobe levels and low average return loss over a specified frequency bandwidth. It is a challenge to meet such specifications over a frequency range when one uses resonant elements such as waveguide feed slots. In addition to their inherent narrow frequency band performance, the problem is exacerbated due to modeling errors and manufacturing tolerances. There was a need to develop a design methodology to solve the problem.

An iterative design procedure was developed by starting with an array architecture, lattice spacing, aperture distribution, waveguide dimensions, etc. The array was designed using Elliott's technique with appropriate values of the total slot conductance in each radiating waveguide, and the total resistance in each feed waveguide. Subsequently, the



The **Slot Array Architecture** consists of four machined mechanical layers forming three electrical layers as shown in the figure.