NASA TECH BRIEF
NASA Pasadena Office

Improved Technique for Inspection of Planar Surfaces by Microscopy and Interferometry

The usual examination of processed planar surfaces by microscopy can be substantially improved by a novel technique in which incident white light and an ordinary interferometer attachment are made to provide images that differ in color according to the relative heights of the planar surfaces. Color, hue, shade, or tint is constant over a uniformly flat surface; gradations of color, hue, shade, or tint indicate variations of from 200 to 10,000 angstroms in the height of the surface. With the aid of this technique, it is possible to perceive buried layers, such as diffused collectors, which normally cannot be seen under the epitaxial layer which overlays them; it is also possible to discover defects in buried layers.

An industrial type binocular microscope with a 100-watt quartz–iodine incident light attachment is equipped with a Linnick-type interferometer; preferably, a trinocular arrangement is employed so that color photographs can be also taken or a color television pickup and display system can be used for large-screen viewing.

Focusing of the system is first accomplished in the usual fashion with the interferometer attachment inactive (set at a neutral position); the sharpest image of the area under study is obtained either in a bright or a dark field, but illumination is changed over to bright field if the focus was obtained by dark field. Then, the 90-percent reflectivity mirror of the interferometer attachment is selected and its tilt and rotation controls are adjusted so that a good interference fringe line display is produced on the surface of the epitaxial layer. Minor refocusing may be necessary to center the fringe line pattern in the field of view.

The interference mirror is now carefully rotated to expand the interference pattern in such a way that just one fringe line (preferably a black line rather than one of the chromatic lines) covers the entire field of view. Slight adjustments of focus may be necessary because the line will waver and may move out of the field of view. By continual adjustment of the mirror and refocusing as necessary, a critical stage is reached at which the display settles either into a monocolor field (if only a single level is being viewed) or a multicolored field on which plateaus at different levels are seen in different colors. Focus is further adjusted until any desired level appears black; black may be used as a reference for any quantitative measurements subsequently made.

As fine focus is subsequently varied in minute degrees, the coloration of each discrete height level will change, but all height levels register the same color. The different colors will sharply delineate each vertically distinguishable surface, and differences in heights can be obtained from the calibration scale on the fine-focus control; for example, slight differences in color between the edges and the inner parts of an island reveal that the edges are at a different level.

The technique is restricted to observations of highly polished, substantially planar surfaces which can reflect color fringing under incident white light.

(continued overleaf)

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 73-10143

Patent status:

NASA has decided not to apply for a patent.

Source: Daniel S. Doubt of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11893)