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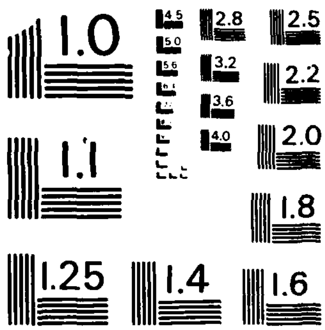

MICROCOPY RESOLUTION TEST CHART

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RECENT IMPROVEMENTS IN REAL TIME GAS ELECTRON DIFFRACTION

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Since our first reports [1]-[2], real-time data acquisition for GED has continued to evolve [3]-[5]. The angular range of simultaneous detection has been increased to an included angle of 40°, for a momentum transfer maximum of s > 300 rad/nm. Thus, the technique has been enhanced to a point where it appears to rival the traditional photographic method of GED data collection: structural parameters can be determined with the accuracy of photographic work, but mean amplitudes of vibration are still slightly larger compared with the literature values.

In summary, a 40 KeV focused electron beam intersects an effusive gas jet and the scattering pattern generated is displayed on a fluorescent screen ~~(see Figures page)~~. Currently the screen is optically coupled by a transfer lens to the photodiode array sensor, where as many as 1024 independent and equidistant channels record the angular dependence and intensity profile of the scattered electrons. Thus, in a matter of minutes, entire scattering cross sections are available for analysis. In contrast to the feedback latency inherent in photographic practice, this rapid data collection and interpretation allows for immediate on-line optimization of experimental conditions.

The attached figures visually document the newly achieved resolution. To obtain these curves, both instrumental and analytical improvements were necessary. Further cooling of the sensor array, interposition of a "butterfly" slit in the instrument's optical track, and the use of a larger aperture transfer lens have impacted upon the noise margin, dynamic range of simultaneous detection, and overall system gain factor, respectively. A method of ratiometry of data sets has been developed [3] and has proven effective in minimizing both high frequency noise and non-random channel gain and offset effects. Pending instrumental improvements are expected to alleviate the amplitude problem and further to increase gain and range, making the technique suitable for characterization of extremely weak signals, such as those expected to occur in pulsed electron probe experiments of excited species.

In addition to testing the procedure with established molecular structures [3], we have also collected data for some unknown systems: trans 1,2-dichloroethene [5], 1,2-epoxyethane, and di-tert-butylperoxide [reports in preparation]. Without exception, the structural results agree with concomitant ab initio calculated trends.

1) J.D. Ewbank, L. Schafer, D.W. Paul, and O.J. Benston, Tenth Austin Symposium on Molecular Structure, Austin, Texas (1984).

2) J.D. Ewbank, L. Schafer, D.W. Paul, O.J. Benston, and J.C. Lennox, Rev. Sci. Instrum., 55, 1598 (1984).

3) J.D. Ewbank, L. Schafer, D.W. Paul, D.L. Monts, and W.L. Faust, Rev. Sci. Instrum., in press.

4) IR-100 Award, Research & Development, October, 1985.

5) L. Schafer, J.D. Ewbank, K. Siam, D.W. Paul, and D.L. Monts, submitted to J. Mol. Struct.

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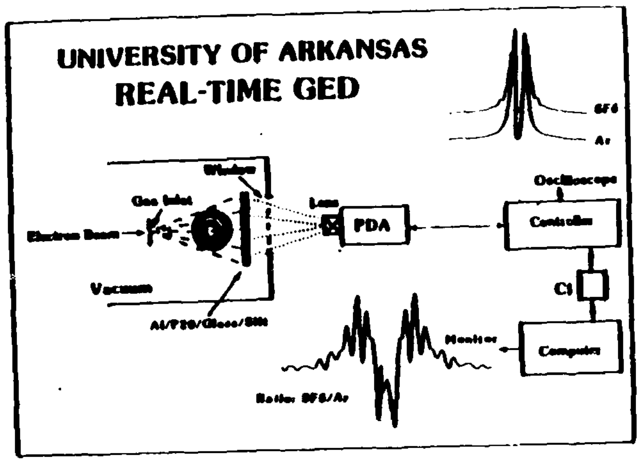
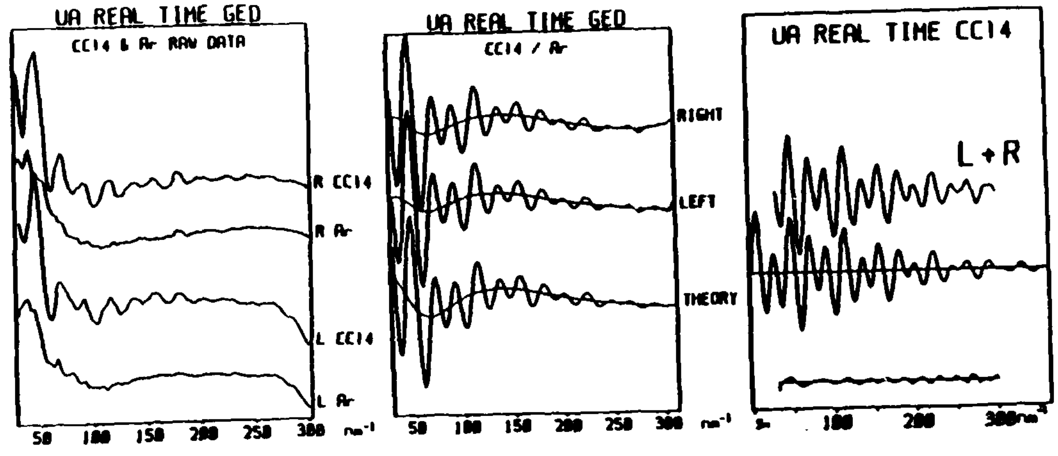
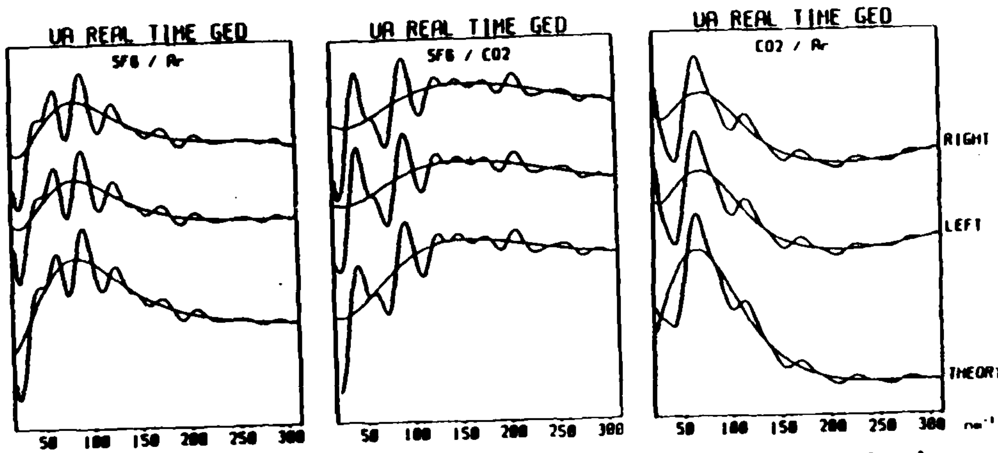


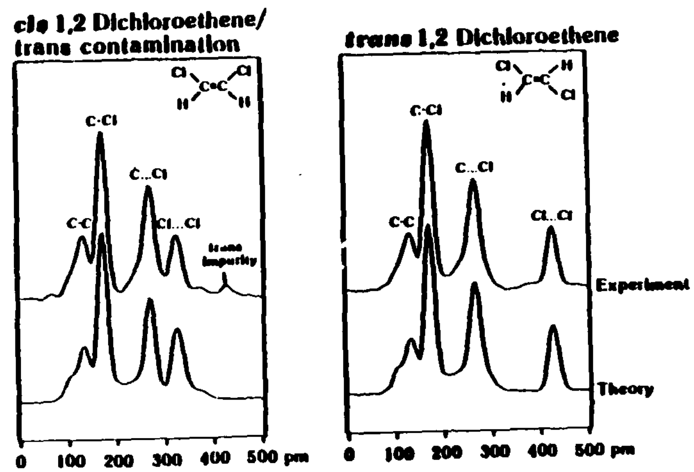
CONFIGURATION SCHEMATIC, OPTICAL TRANSFER LENS SYSTEM



"RAW", RATIOMETRIC, AND sM(s) CURVES FOR A SINGLE EXPERIMENT WITH CCl_4 & ARGON



EXPERIMENTAL RAW DATA PAIRWISE RATIOS FOR THE MOLECULAR SET -- SF_6, CO_2, AR -- AND THEIR THEORETICAL COUNTERPARTS



IMPURITY DETECTION IN THE 1,2 DICHLOROETHENES

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