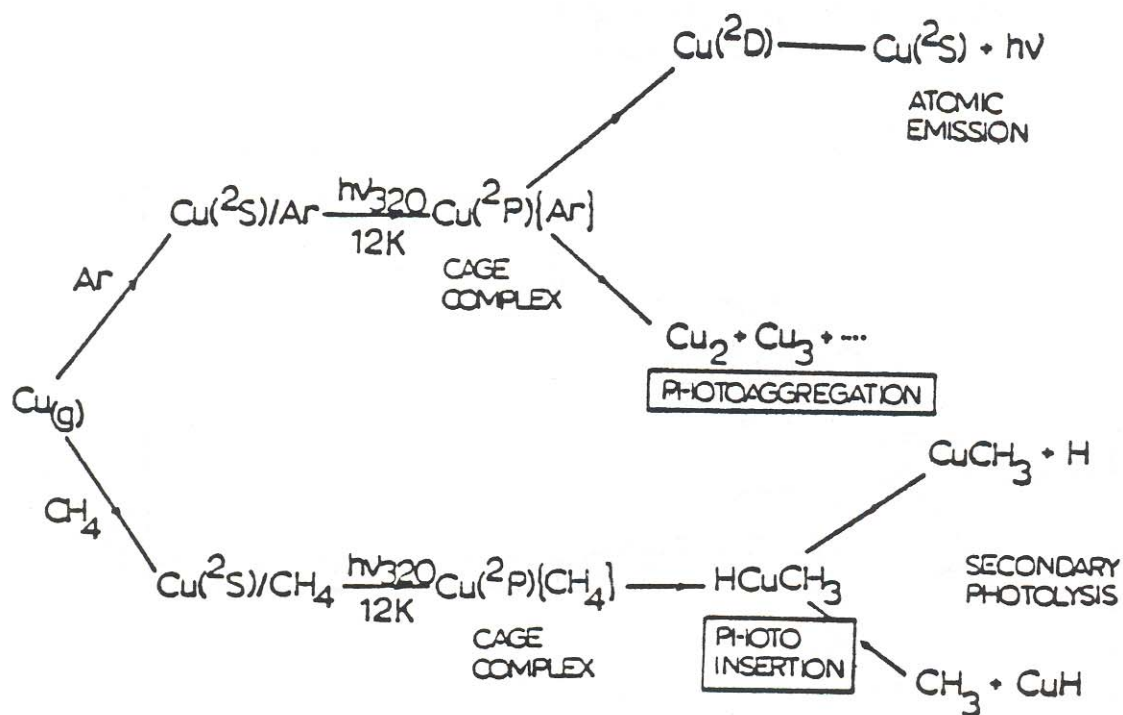


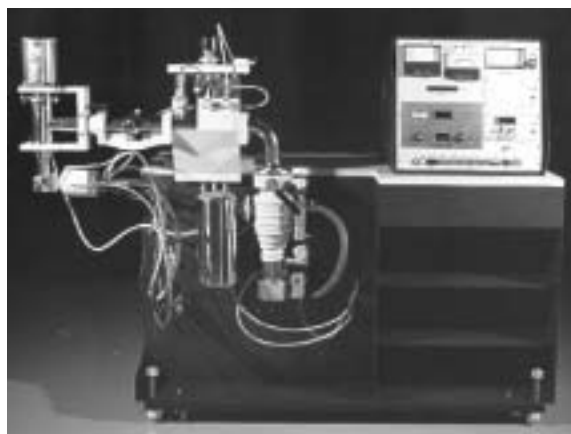
TORROMIS

A Comprehensive and Compact New Generation of Matrix Isolation Equipment for the Synthesis and Spectroscopic Study of a Wide Range of Organic, Inorganic and Organometallic Compounds.

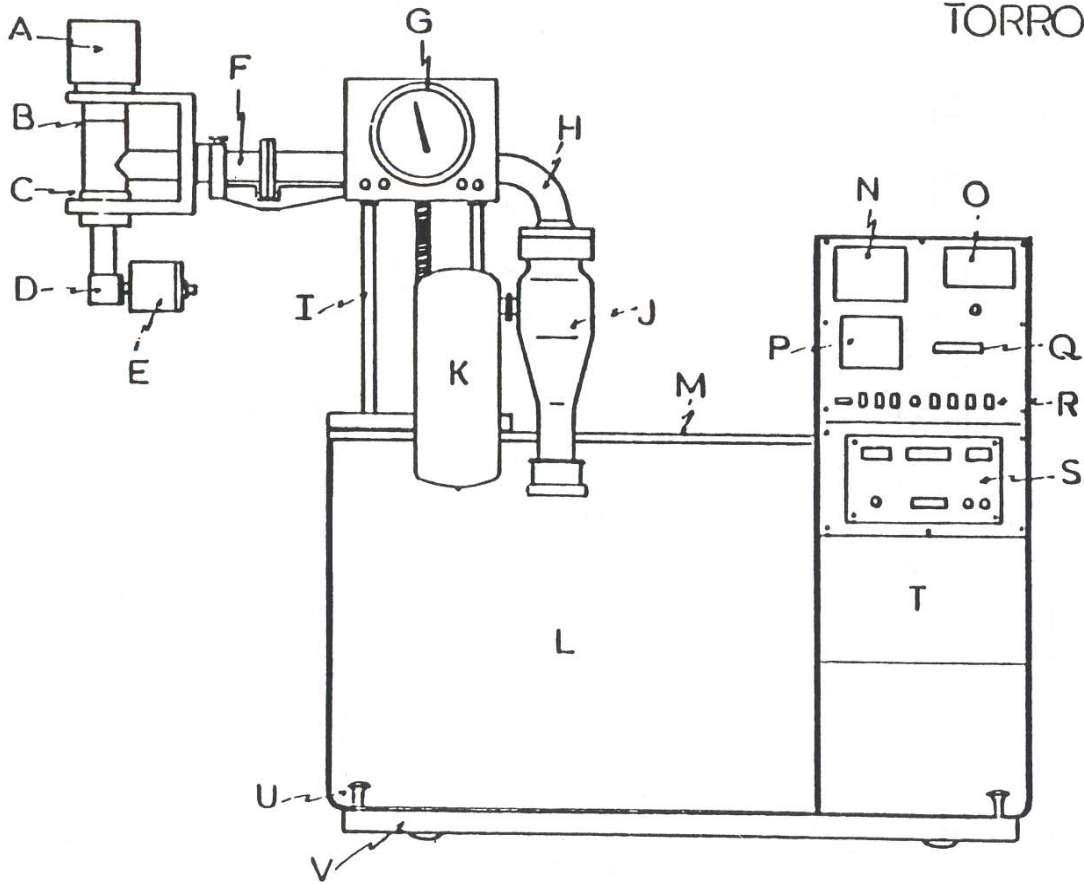
TWO IMPORTANT PHOTOPROCESSES OF OPTICALLY EXCITED COPPER ATOMS



Torromis Industries Incorporated, Manufacturers of Metal Vapor Synthesis, Matrix Isolation and Scientific Equipment.



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Figure Notation

- A. Closed cycle helium refrigerator, displacer head
- B. Rotation seal for cold end
- C. Rotation seal for vacuum furnace assembly
- D. Reaction chamber, four window ports plus gas entry jets, fibre optics adapter (optional)
- E. Water cooled vacuum furnace (single, double or triple vapourization source, with in situ quartz crystal microbalance assembly)
- F. Rotation seal assembly for horizontal or vertical operation
- G. Gas handling, monitoring and flow control assembly
- H. Vacuum manifold (2 inch O.D.)
- I. X,Z translation stage providing 8 inch x 12 inch movement of entire matrix assembly
- J. Cryodiffstack pumping unit
- K. Liquid nitrogen trap
- L. Easy access cabinet, housing, vacuum furnace transformer assembly and direct drive rotary pump
- M. Working surface
- N. Cold cathode vacuum gauge
- O. Stabilized current control unit for vacuum furnace vapourization source
- P. Thermo-couple vacuum gauge
- Q. Quartz crystal microbalance, power supply, oscillator and frequency counter
- R. Electronics power control switches
- S. Proportionate temperature controller for closed cycle refrigerator (10 - 300K)
- T. Multiple shelf storage space (front and back)
- U. Manual levelling floor jacks
- V. Caster positioning of unit

Note that TORROMIS has been designed to be suitable for experiments involving the generation and trapping of reactive intermediates and/or products, under solid, liquid or solution phase conditions. Reagents may be conventional gaseous reagents or high temperature metal, metal oxide or metal salt vapours to name a few. Samples and reagents can be subjected to a range of thermal photolytic, x-ray, y-ray, microwave, radiowave, etc. treatments, either during or after a deposition. It has been used extensively in conjunction with conventional uv-visible, fluorescence, grating and Fourier Transform IR, laser Raman, resonance Raman, resonance fluorescence and electron spin resonance spectroscopies.



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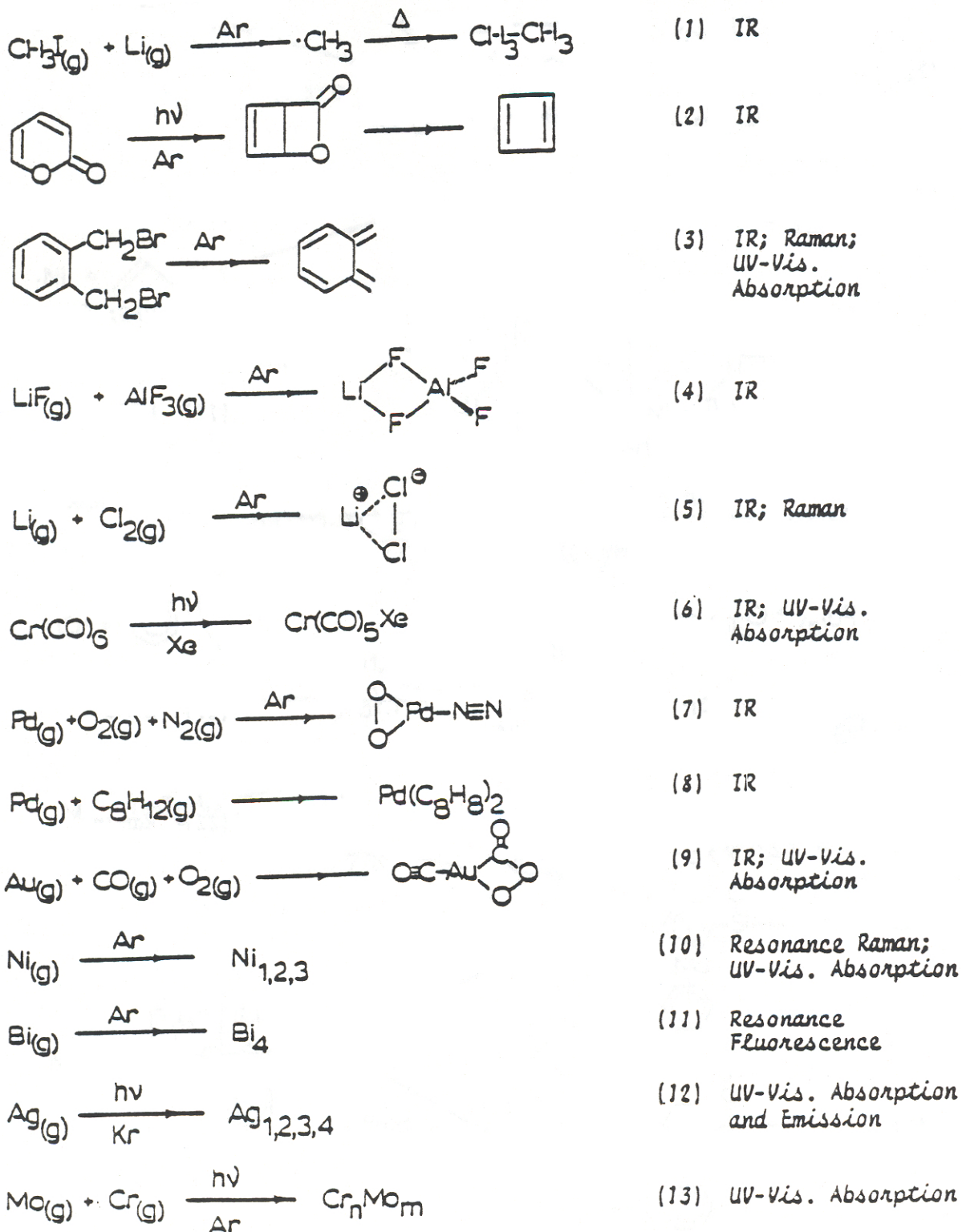
TORROMIS is a highly compact matrix isolation system based on University of Toronto processing designs suitable for performing microscale chemistry with both atomic and molecular reagents. This type of equipment has been widely used for the matrix synthesis of many novel inorganic, organometallic, organic and polymeric materials which have proven to be of considerable interest to a multidisciplinary group of scientists. The following is a brief outline of its operating principle.

By inserting an appropriate window material into a cold finger, held in a reaction chamber, the temperature of the window can be maintained over a chosen temperature range of 10 - 300K in an evacuated environment. Adjacent to the cold finger is mounted a water cooled vacuum furnace that by virtue of a resistance heated power supply, will produce a source of evaporated material. An in situ quartz crystal mass monitor allows quantitative control of the deposition rate of the high temperature reagent. A micro vacuum shutter system permits the isolation of the furnace system from the reaction chamber. A gas flow system supplies a known amount of vapour to the reaction chamber and is arranged to provide intimate mixing of the evaporant and gas inlet streams on the sample window.

Matrix isolation synthesis is achieved by co-condensation of the two vapour phases on the cooled window. An X/Z translation stage allows adjustment of the sample window with respect to the spectrometer for reaction product examination.

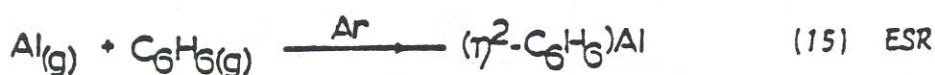
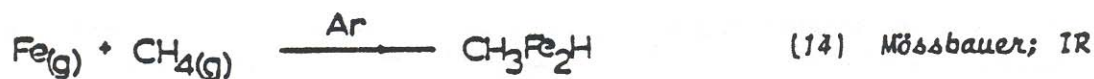
Some interesting examples of matrix isolation synthesis as illustrated in the following pages.

As the number of novel chemical synthesis employing highly reactive and transient species increases, it is becoming increasingly evident that the methods of the preparative and the matrix chemist are intimately related. An intelligent combination of the two techniques therefore can compliment and supplement each other, thereby adding a new dimension to the scope of spectroscopic study and chemical synthesis.





The TORROMIS preparation and sampling chamber has been designed to be compatible with many of the broad range of spectroscopic probes which can be applied to matrix-isolated species in order to obtain detailed molecular and electronic structure information. Some of these are illustrated below:



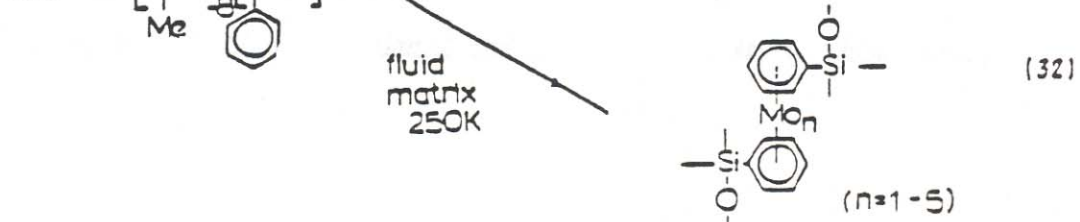
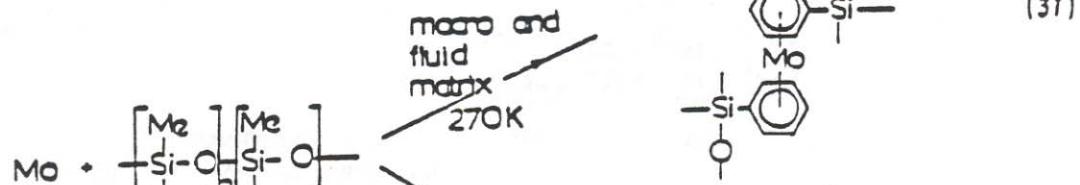
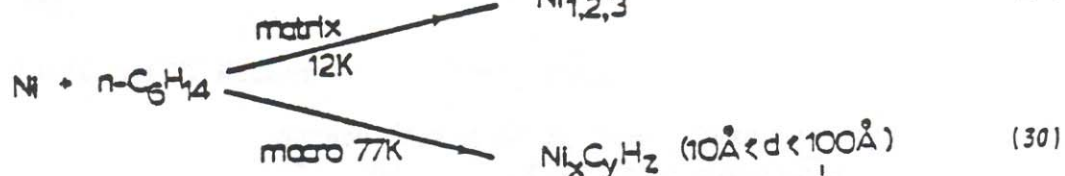
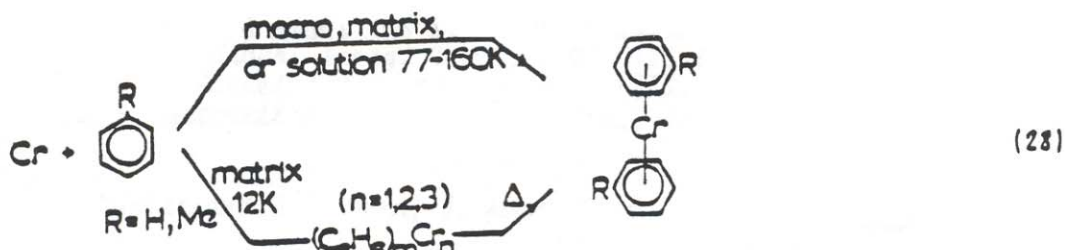
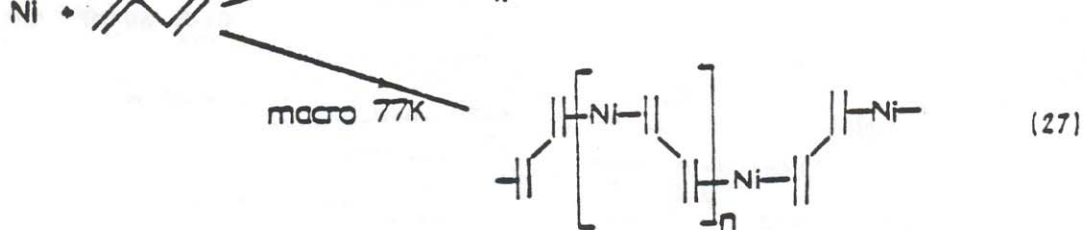
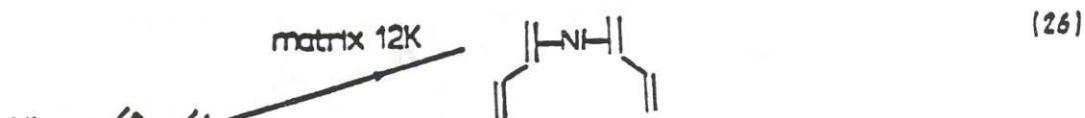
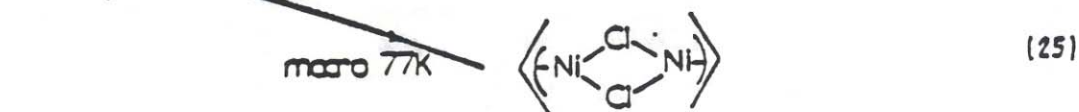
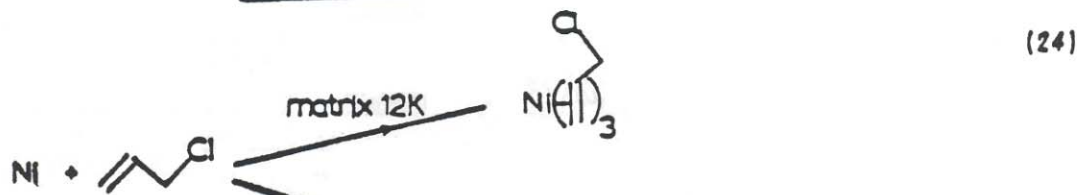
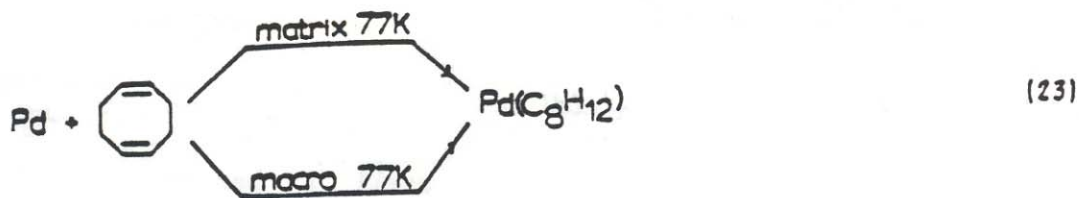


Spectroscopic information on species of this kind is of considerable relevance to researchers in fields as diverse as organometallic synthesis, nucleation theory, surface science and catalysis, and cluster chemisorption model theory, to name a few.

The TORROMIS equipment offers numerous other opportunities for innovative synthetic and spectroscopic research. For example, metal atom diffusion, aggregation and complexation process can be studied under a variety of reaction conditions. TORROMIS can therefore be of value in the design of large scale TORROVAP synthesis; in other words, a combination of TORROMIS and TORROVAP techniques can work to the benefit of each. A TORROMIS exploratory experiment can provide a rapid convenient method for

- (i) selecting reaction conditions to optimize yields of desired products
- (ii) establish the identity of different species formed under a range of operating conditions (solid, liquid and solution phase)
- (iii) monitoring chemical transformations during warm-up
- (iv) determining product decomposition temperatures prior to a macroscale TORROVAP synthesis.

Some examples which demonstrate the value of a combined TORROMIS / TORROVAP approach in metal vapour synthesis are shown on the following page:





References

- (1) W.L.S. Andrews and G.C. Pimental, *J. Chem. Phys.*, 1966, 44, 2527; 1967, 47, 3637.
- (2) C.Y. Lin and A. Krantz, *J. C. S., Chem. Comm.*, 1972, 1111; O.L. Chapman, C.L. McIntosh and J. Pacansky, *J. Amer. Chem. Soc.*, 1973, 95, 614.
- (3) K.L. Tseng and J. Michl, *J. Amer. Chem. Soc.*, 1977, 99, 4840.
- (4) S.J. Cyvin, B.N. Cyvin and A. Snelson, *J. Phys. Chem.*, 1971, 75, 2609.
- (5) W.F. Howard Jr. and L. Andrews, *Inorg. Chem.*, 1975, 14, 767.
- (6) R.N. Perutz and J.J. Turner, *J. Amer. Chem. Soc.*, 1975, 97, 4791.
- (7) G.A. Ozin and W.E. Klotzbucher, *J. Amer. Chem. Soc.*, 1975, 97, 3965.
- (8) R.M. Atkins, R. MacKenzie, P.L. Timms and J.W. Turney, *J. C. S., Chem. Comm.*, 1975, 764.
- (9) H. Huber, D. McIntosh and G.A. Ozin, *Inorg. Chem.*, 1977, 16, 975.
- (10) M. Moskovits and D.P. Dilella, *J. Chem. Phys.*, 1980, 72, 2267; M. Moskovits and J.E. Hulse, *J. Chem. Phys.*, 1977, 66, 3988.
- (11) V.E. Bondybey and J.H. English, *J. Chem. Phys.*, 1980, 73, 42.
- (12) G.A. Ozin and H. Huber, *Inorg. Chem.*, 1978, 17, 155; G.A. Ozin, S. Mitchell, J. Farrel and G. Kenney-Wallace, *J. Amer. Chem. Soc.*, 1980; G.A. Ozin, S. Mitchell and G. Kenney-Wallace, *J. Amer. Chem. Soc.*, 1981.
- (13) W.E. Klotzbucher and G.A. Ozin, *J. Amer. Chem. Soc.*, 1978, 100, 2262.
- (14) P.H. Barrett, M. Pasternak and R.G. Pearson, *J. Amer. Chem. Soc.*, 1979, 101, 222.
- (15) P.H. Kasai and D. McLeod Jr., *J. Amer. Chem. Soc.*, 1979, 101, 5860.
- (16) P.A. Montano and G.K. Shenoy, *Solid State Comm.*, 1980, 35, 53; P.A. Montano, P.H. Barrett and H. Micklitz, *Ber. Bunsengesellschaft, Phys. Chem.*, 1978, 82, 37.
- (17) K. Jacobi, D. Smeisser and D.M. Kolb, *chem. Phys. Lett.*, 1980, 69, 113; F. Ahmed and E.R. Nixon, *J. Chem. Phys.*, 1979, 71, 3547.
- (18) R. Grinter, S. Armstrong, U.A. Jayasooriya, J. McCombie, D. Norris and J.P. Springall, *Faraday Symp. Chem. Soc.*, 1980, 14.
- (19) K.W. Zilm, R.T. Colin, D.M. Grant and J. Michl, *J. Amer. Chem. Soc.*, 1978, 100, 8038.
- (20) D.W. Green and G.T. Reedy, *J. Chem. Phys.*, 1978, 69, 544.
- (21) H.T. Jonkman and J. Michl, *J. C. S., Chem. Comm.*, 1978, 751.
- (22) W. Schulze, H.U. Becker, R. Minkwitz and K. Mansel, *Chem. Phys. Lett.*, 1978, 55, 59.
- (23) R.M. Atkins, R. MacKenzie, P.L. Timms and J.W. Turney, *J. C. S., Chem. Comm.*, 1975, 764.
- (24) G.A. Ozin and W.J. Power, *Inorg. Chem.*, 1978, 17, 2836.
- (25) M.J. Piper and P.L. Timms, *J. C. S. Chem. Comm.*, 1972, 50.
- (26) G.A. Ozin and W.J. Power, *Inorg. Chem.*, 1980.
- (27) P.S. Skell, J.H.J. Havel, D.L. Williams-Smith, M.J. McGlinchey, *J. C. S., Chem. Comm.*, 1972, 1098.



References Cont'd.

- (28) P.L. Timms, J. C. S. Chem. Comm., 1969, 1033; C.G. Francis, H. Huber and G.A. Ozin; L.F. Nazar, reference 39 in G.A. Ozin and C.G. Francis, J. Mol. Struct., 1980, 59, 55; H.F. Efner, D.E. Tevault, W.B. Fox and R.R. Smardzewski, J. Organometallic Chem., 1978, 146, 45.
- (29) W. Klotzbucher, S. Mitchell and G.A. Ozin, unpublished work.
- (30) K.J. Klabunde, H.F. Efner, T.O. Murdock and R. Ropple, J. Amer. Chem. Soc., 1976, 98, 1021.
- (31) C.G. Francis and P.L. Timms, J. C. S. Chem. Comm., 1977, 466; J. C. S. Dalton, 1980, 1401; C.G. Francis, H. Huber and G.A. Ozin, Inorg. Chem., 1980, 19, 219.
- (32) C.G. Francis, H. Huber and G.A. Ozin, Inorg. Chem., 1980, 19, 219; J. Amer. Chem. Soc., 1979, 101, 6250; Agnew. Chem. Int. Edn., 1980, 19, 402; C.G. Francis and G.A. Ozin, J. Mol. Struct., 1980, 59, 55; J. Macromol, Sci.;