

GEORGIA INSTITUTE OF TECHNOLOGY

OFFICE OF RESEARCH ADMINISTRATION

RESEARCH PROJECT INITIATION

Date: April 6, 1971

Project Title: Laser-excited Raman and Temperature-Jump Dynamic Studies of Enzymes

Project No: B-1597

Principal Investigator Dr. Nai-Teng Yu

Sponsor: Research Corporation

Agreement Period: From March 24, 1971 Until March 23, 1972

Type Agreement: Letter Grant dated March 24, 1971

Amount: \$6,150

Reports Required: Progress reports when appropriate  
Financial Report upon completion of work

Sponsor Contact Person (s): Dr. Jack powers  
Research Corporation  
6075 Roswell Rd., N.E.  
Atlanta, Georgia 30328

Assigned to: School of Chemistry

COPIES TO:

Principal Investigator	Library
School Director	Rich Electronic Computer Center
Dean of the College	Photographic Laboratory
Director, Research Administration	Project File
Deputy Controller (2)	
Security-Reports-Property Office	
Patent Coordinator	Other _____

GEORGIA INSTITUTE OF TECHNOLOGY

OFFICE OF RESEARCH ADMINISTRATION

*No action  
A.S.B.*

RESEARCH PROJECT TERMINATION

Date: October 18, 1973

Project Title: "Laser-excited Raman and Temperature - Jump Dynamic Studies of Enzymes"

Project No: G-33-630

Principal Investigator: Dr. Nai-Teng Yu

Sponsor: Research Corporation

Effective Termination Date: October 20, 1973

Clearance of Accounting Charges: all charges are clear

*M 129 N-*

and title page? Imperfect volumes delay return of binding. Thanks.  
BOUND BY THE NATIONAL LIBRARY BINDERY CO. OF GA.

COPIES TO:

- Principal Investigator
- School Director
- Dean of the College
- Director of Research Administration
- Associate Controller (2)
- Security-Reports-Property Office
- Patent and Inventions Coordinator
- Library, Technical Reports Section
- Rich Electronic Computer Center
- Photographic Laboratory
- Terminated Project File No. \_\_\_\_\_
- Other \_\_\_\_\_

# REPORT OF RESEARCH CORPORATION GRANT

(Please check one)

(Submit original and one legible copy)

- Interim Report  
 Terminal Report

## INSTITUTION AND ADDRESS

Georgia Institute of Technology  
Atlanta, Georgia 30332

PRINCIPAL INVESTIGATOR Yu, Nai-Teng, Assistant Professor of Chemistry PHONE (404) 894-4007

## ACADEMIC RANK AND DEPARTMENT

## SHORT TITLE OF RESEARCH SUPPORTED BY GRANT

Laser-excited Raman and Temperature-jump Dynamic studies of Enzymes

STARTING DATE March 23, 1971.

SUMMARY OR PRINCIPAL FINDINGS AND THEIR SIGNIFICANCE (State succinctly in language understandable to one not necessarily expert in this field. Include extent to which original goals have been realized and any changes to original plan made or contemplated.)

1. Raman spectroscopy was found to be very sensitive to insulin conformation. Striking and interesting spectral changes upon globular-fibrous transformation of insulin have been analyzed in detail. The structural information thus obtained is of considerable biological importance.
2. Raman spectra of insulin in crystals and in solution have been obtained and compared. Significant conformational changes of insulin on going from crystals to solution have been observed. This type of information is not obtainable by X-ray diffraction and nuclear magnetic resonance techniques. In the near future, Raman spectroscopy is expected to be a unique and powerful tool for studying the structures and conformations of proteins in both crystals and solution.
3. It was found by Raman spectroscopy that the insulin moiety exists in a conformation very nearly the same as insulin itself and that the C-peptide contains both  $\alpha$ -helical and random-coil structure in proinsulin. It is speculated that the function of C-peptide is to bring the necessary cysteine residues into juxtaposition for the correct formation of disulfide linkages and that once three disulfide bonds are formed, the insulin moiety becomes highly stabilized and the cleavage of the C-peptide from proinsulin will not appreciably change the existing conformation of the insulin moiety. These findings may be of considerable biological significance.
4. Raman spectra of  $\alpha$ -lactalbumin have also been studied. The local geometry of the four disulfide cross-links were found to be nearly the same as in lysozyme. The chain conformation is also quite similar in both proteins.
5. Raman technique was found to be useful in telling whether the tyrosine residues in a protein are "buried" in the interior of the molecule or "exposed" to the surface.
6. Raman spectra of RNase A single crystals were obtained for the first time. Comparison of crystals and solution spectra indicated that backbone conformations are the same in both phases but side-chain conformational differences may exist.

Our main emphasis during the past two years has been in developing laser Raman technique for detailed structural studies of proteins. We are now applying this technique to study the mechanism of cataract lens formation. In addition to our Raman work, Dr. E. J. East, a recently appointed postdoctoral fellow, will carry out some kinetic studies by using the T-jump apparatus constructed in our laboratory.

REPORT OF RESEARCH CORPORATION GRANT

Page-2

STUDENT PARTICIPATION (Give names of students working on the project, their role in the research, their achievements and their career plans.)

1. MR. CHRISTOPHER S. LIU, assisted in developing techniques for obtaining Raman spectra of proteins; his work has resulted in five publications; he received a M.S. degree from Georgia Tech; now he is a Ph.D. candidate at M.I.T.
2. MRS. JOHANNA CULVER, laser Raman scattering of zinc-insulin crystals and T-jump apparatus construction; contributed to the first publication from my research group; received a B.S. degree from Georgia Tech; now working as a research chemist in T-jump field at VA Hospital - 4801 Linwood, Kansas City, Mo. 64128.
3. MR. B. H. JO, laser Raman experiments on cobramine B, lysozyme and ribonuclease A; four papers published. Ph.D. candidate at Georgia Tech.

PAPERS AND SCIENTIFIC TALKS (Give titles and references to papers or talks resulting from the work. Attach two copies of any reprints available, if not previously forwarded.) Papers: 1. N.-T. Yu, C. S. Liu, J. Culver and D.C. O'Shea B.B.A. 263, 1 (1972); 2. N.-T. Yu and C. S. Liu, JACS, 94, 3250 (1972); 3. N.-T. Yu, and C. S. Liu, JACS, 94, 5127 (1972); 4. N.-T. Yu, C.S. Liu and D.C. O'Shea, J. Mol.Biol., 70, 117 (1972) 5. N.-T. Yu, B.H. Jo and C.S. Liu, JACS, 94, 7573 (1972); 6. N.-T. Yu, B.H. Jo and D.C. O'Shea, Arch. Biochem. Biophys., 156, 71 (1973); 7. N.-T. Yu and B.H. Jo, Arch. Biochem. Biophys., 156, 469 (1973); 8. N.-T. Yu and B.H. Jo, JACS, 95, 5033 (1973). Talks: 1. Colorado State University. 2. ACS National Meetings

OTHER SUPPORT (List amounts and sources—including institutional—of other contributions received or expected for this work.)

1. NIH ROI GM 18894-01 and -02, \$37,262. Expected, NIH GM 18894-03, \$20,602
2. Georgia Tech, School of Chemistry, \$14,000, (primarily for equipment)
3. Research Corporation, \$22,000, a special grant for a related project: "Laser Raman Studies on the Mechanism of Cataract Lens Formation" starting March, 1973

EXPENDITURE OF RESEARCH CORPORATION GRANT FUNDS (The terminal report should be approved by an authorized officer of the institution.)

a. Equipment, supplies (Itemize major expenditures)

1. Projected Graticul and accessories \$196.55;
2. Operational Amplifier type O, \$550.00;
3. Dispenser ammonium sulfate, \$187.90;
4. photodiode \$147.62;
5. Nikon lens \$142.65;
6. Pocket Calculator, \$399.95;
7. Microscope with Camera \$434.00;
8. UV meter \$124.50;
9. Power source PD-9 \$749.40;
10. Biochemicals, protein models, electronic components etc. \$2192.43

Total \$5,125

b. Stipends (Academic status, rates, periods of appointment)

C. S. Liu, graduate student - \$300/mo., 3 months	\$900
J. Culver, undergraduate assistant, \$2.00/hr., 62.5 hours	\$125
Total	\$1,025

c. Other expenditures (Itemize and give purpose)

Signature of principal investigator

Date

March 26, 1973

Signature of authorized officer of institution (required for terminal report only)  
Associate Director of Financial Affairs

Date

August 21, 1973

Name and position of authorized officer of institution