FINAL REPORT

1994

DOE

DE-FG05-ER61226

over past 3-year funding period (9/91- 9/94)

DOE CENTER OF EXCELLENCE IN MEDICAL LASER APPLICATIONS

Univ. of Texas M. D. Anderson Cancer Center
Univ. of Texas Medical Branch - Galveston
Univ. of Texas - Austin
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RESEARCH ACTIVITIES |

2

The research has focused on 5 projects:

Spectroscopy
Imaging
PhotoDynamic Therapy
Controlled Photocoagulation
Laser Surgery.

A major goal is to bring specific projects to the clinic during the proposed funding period. Therefore, the projects are specifically tied to several examples of clinical translation.

MANAGEMENT

The teams taking responsibility for various aspects of the five projects are listed in a collaborative matrix. Although each project has common equipment, techniques, theory, and analysis, the unique translation into a particular clinical setting is attributed to a specific team.

COLLABORATIVE MATRIX

	Spectroscopy	Imaging	Coagulation	PDT	Laser Surgery	---
UTMDA	X	X	X	X	X	
UTMB	X	X	X	X	X	
UTA	X	X	X		X	
TAMU			X	X	X	
NRL					X	

PUBLICATIONS

The following lists the publications and presentations of our DOE Center during the past 3-year funding period. The work reported in these publications benefited either *directly* or *indirectly* from the DOE support.

Summary:

Journal Papers	54
Submitted Papers	13
Conference Proceedings Papers	93
Book Chapters	25
Theses	22
Abstracts	57

JOURNALS

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LeCarpentier, G.L., W. F. Cheong, R.J. Crilly, M. Motamedi, A J. Welch, "The Role of Thermal Weakening of Tissue in Ablation Onset," Am. Soc. for Laser Medicine & Surgery Annual Meeting, Lake Buena Vista, FL, May 17-19, 1992.

Nemati, B., H.G. Rylander, III, AJ. Welch, "Optical Properties of Conjunctiva, Sclera, and Ciliary Body and Their Consequences for Transscleral Cyclophotocoagulation," Am. Soc. for Laser Medicine & Surgery Annual Meeting, Lake Buena Vista, FL, May 17-19, 1992.

Springer, T., AJ. Welch, S. Thomsen, "Temperature Controlled Vessel Welding," Am. Soc. for Laser Medicine & Surgery Annual Meeting, Lake Buena Vista, FL, May 17-19, 1992.

Welch, AJ. " Exposure Durations, " Controversies in Cutaneous Laser Surgery Conference, Aspen, CO., August 28, 1992.

Welch, A.J., J.A. Pearce, KR. Diller, "Rate Process Modeling of Laser Induced Thermal Damage in Tissue," 1992 National Heat Transfer Conf., San Diego, Aug., 1992.

Internet network:

25

The member sites maintain regular interaction via Internet, both via email and via direct access to the SUN workstations at UTMDA and UTMB. Also, the center maintains an FTP facility (@laser.mda.uth.tmc.edu, password: <anonymous>) which enables investigators worldwide to gain access to the library of modeling programs and tissue properties which the center is compiling.

Yearly conference:

Each February, at the annual Houston Biomedical Engineering Society conference which draws about 250 participants from the Texas community, a special conference on Lasers in Medicine is held. Participants are primarily students and investigators from the DOE center. This occasion allows formal presentations of work in progress in a forum attended by nearly all the principal and primary investigators. The presentations of this annual meeting for the last 3 years follows:

1992 10th Annual Houston Conference

Laser Tissue Interactions

SL Jacques-UTMDA

Modeling Laser Propagation in Tissues Using a Hybrid Monte Carlo Diffusion Theory

L Wang - UTMDA

Photodynamic Therapy for Killing Cancer Cells

XY He - UTMDA

Optical Properties of the Conjunctiva, Sclera, and Ciliary Body and Their Consequences for Trans-Scleral

Cyclophotocoagulation

B Nemati, HG Rylander, III, and AJ Welch-UTA

Role of Temperature Dependence of Optical Properties in Laser Irradiation of Tissue

BM Kim, S Rastegar, and SL Jacques* - TAMU and *UTMDA

Response of Canine Prostate to Nd:YAG Laser Irradiation: Thermographic Analysis and Histologic Correlation

JT Cammack, M Motamedi, JH Torres, E Orihuela and MM Warren - UTMB

Studies of UV and MID-JR Laser Ablation of Tissue

B Edelen, S Rastegar, M Moore and K Kadipasaoglu* - TAMU and *Texas Heart Inst.

Simulation of Optical Absorption and Scattering in Gel and Egg White

SS Kumbhani and S Rastegar - TAMU

Diode Lasers in Medicine

A Hielscher, J Schwartz*, SL Jacques* and F Tittel - RICE and *UTMDA

Photocoagulation of Myocardial Tissue: Comparison of Diode and Nd: YAG Lasers

M Motamedi, SL Jacques*, S Rastegar, ** D.Jansen, *** S Thomsen* - UTMB,

*UTMDA, **TAMU ***UTA

The Role of Blood on Tissue Coagulation During Diode Laser Irradiation

CT Shen, EDJansen, M Motamedi, *SL Jacques, **S Rastegar, *** and AJ Welch - UTA, *UTMB, **

UTMDA, and ***TAMU

Modeling of Intraluminal Heating of Tissue by Laser and by Contact Heating: Implications for Prostate Treatment

B Anvari, M Motamedi and S Rastegar* - UTMB and *TAMU

Digital Tracking and Control of Retinal Images

SF Barrett, AJ Welch, HG Rylander, III and MRJerath - UTA
Optical Polarimetric approach to Noninvasive Glucose Sensing
GL Core - TAMU
Video Reflectometry to Specify Laser Dosimetry
A Gutsche, J Schwartz and S Jacques - UTMDA
Laser Flash-Photography of Laser-Induced Photomechanical Effects
SL Jacques and G Gofstein - UTMDA

1993 11th Annual Houston Conference

Fluorescence spectroscopy in Tissue

CM Gardner, SL Jacques*, YG Chung*, JA Schwartz*, and AJ Welch- UTA and
*UTMDA Interpreting Fluorescence Spectra of Turbid Media

R Richards-Kortum, T Durkin and J Zeng - UTA

Brain Autofluorescence: In Vivo Excitation/Emission Matrix Measured with Optical Fiber
Fluorimeter

YG Chung, CM Gardner*, R Sawaya and SL Jacques - UTMDA and *UTA

Use of Fluorescence for Dosimetry During Photodynamic Therapy

XY He and SL Jacques - UTMDA

Tissue Optics

SL Jacques - UTMDA

Non-Invasive Monitoring of Blood Oxygenation by Phase-Resolved Transmission Spectroscopy

AH Hielscher, SL Jacques*, and FK Tittel - RICE and *UTMDA

Coherence Filtered Photon Imaging of Turbid Media

L Wang and SL Jacques - UTMDA

Video Imaging of the Coagulation Front in Laser Irradiated Albumin

A Azeemi, S Rastegar and N Kehtarnavaz-TAMU

Feedback Controlled Retinal Photocoagulation

AJ Welch, SF Barrett, MRJerath and HG Rylander - UTA

Visualizing Thermal Damage by Loss of Tissue Birefringence

S Thomsen - UTMDA

Effect of Surface Cooling During Intraluminal Laser Irradiation of Tissue

B. Anvari, JH Torres*, M Motamedi*, and S Rastegar - TAMU and *UTMB

Finite Element Analysis of Damage Front Propagation with Controlled Surface Temperature in
Laser Irradiated Tissue

TN Glenn, S Rastegar*, SL Jacques**, and FK Tittel - RICE, *TAMU and **UTMDA

Pulsed Laser Ablation of Biological Tissue Studied by Time-Resolved Detection of Stress
Transients

AA Oraevsky, SL Jacques*, and FK Tittel - RICE and *UTMDA

Laser Ablation of Water at Temperatures Below 100°C Demonstrated by Laser Flash
Photography

GJ Gofstein, AA Oraevsky*, SL Jacques, and FK Tittel* - UTMDA and *RICE

How Micro is Laser Microdissection? Laser Removal of Stratum Corneum of Skin to Expose the
Epidermal Battery

F Ejeckam and SL Jacques* - RICE and *TAMU

Diode Laser Ablation and Coagulation

D Jansen - UTA

1994 12th Annual Houston Conference

Recent Trends in Medical Laser Technology

FK Tittel - RICE

Optical Spectroscopy and Imaging in Medicine

- SL Jacques - UTMDA
An Overview of Laser-Tissue Interactions
AJ Welch - UTA
Photon Density Wave Diffraction Tomography
AH Hielscher, SL Jacques* and FK Tittel - RICE and *UTMDA
Imaging of Turbid Media with a Spatial Filter
L Wang, D.V. Stephens*, AH Heilscher*, FK Tittel*, and SL Jacques - UTMDA and *RICE
Imaging in Layered Biological Tissues Using Time-Resolved Stress Detection with an Acoustic Transducer
AA Oraevsky, SL Jacques*, R Essenaliev, and FK Tittel - RICE and *UTMDA
Laser Spectroscopy for Detecting Potential Early Lesion Formation in Atherosclerosis
TN Glenn, AA Oraevsky, SL Jacques*, FK Tittel and PD Henry**- RICE, *UTMDA and **Baylor
A Theoretical Comparison of Multi-Rate and Single-Rate Kinetics of Thermal Damage in Laser Irradiated Tissue
A Azeemi and S Rastegar - TAMU
Two Methods of Enhancement of Scleral Transmission: Scleral Indentation and Focused Beam Profile
B Nemati, SH Fung, HG Rylander III, and AJ Welch - UTA
Infrared Fiber Sensor for Rapid Temperature Measurement During Laser Heating of Tissue
WC Lin, M Motamedi and AJ Welch* - UTMB and UTA
Temperature Measurement During Photocoagulation of Prostatic Tissue
A Bhattacharya, M Motamedi, S Rastegar*, M Pow-Sang, M LaHayte and E Orihuela - UTMB and *TAMU
Measurement of Prostate Perfusion with a Thermal Diffusion Probe
D Yuan, M LaHaye, M Pow-Sang, D Neal, E Orihuela, M Motamedi, J Valvano* and GC Kramer-UTMB and *UTA
Dye-Enhanced Pulsed IR Laser Ablation of Hard Dental Tissue
E Jennett, M Motamedi, S Rastegar*, C Arcoria** and C xFrederickson*** - UTMB, *TAMU, * ~ Baylor College of Dentistry and ***UT at Dallas
Recoil Pressure and Kinetics of Pulsed Laser Ablation for Strongly and Weakly Absorbing Biological Tissues
RO Esenaliev, AA Oraevsky, SL Jacques** and FK Tittel - RICE and UTMDA
The Dynamics of Laser Ablation of Tissue: Experiments and a Finite Difference Model