

PROJECT ADMINISTRATION DATA SHEET

ORIGINAL



REVISION NO. _____

Project No. E-18-626 R6182-0A0

GTRC/GITZ

DATE 8 / 8 / 86Project Director: Dr. Miroslav I. MarekSchool/~~XXX~~ Materials EngineeringSponsor: DHHS/PHS/NIH/NIDRType Agreement: Grant No. 1 R01 DE07754-01Award Period: From 8/1/86 To 7/31/87 (Performance) 9/30/87 (Reports)

Sponsor Amount:

This ChangeTotal to DateEstimated: \$ _____ \$ 121,370Funded: \$ _____ \$ 121,370

Cost Sharing Amount: \$ _____ Cost Sharing No: _____

Title: Dissolution of Mercury from Dental AmalgamsADMINISTRATIVE DATA

OCA Contact

E. Faith GleasonX-4820

1) Sponsor Technical Contact:

2) Sponsor Admin/Contractual Matters:

William E. Rogers, Jr. PhDRobert GinsbergChief, Caries and Restorative MaterialsGrants Management OfficerResearch ProgramExtramural ProgramsNIDR-EPNIDRBethesda, MD 20892Bethesda, MD 20892(301) 496-7884(301) 496-7437Defense Priority Rating: N/AMilitary Security Classification: N/A

(or) Company/Industrial Proprietary: _____

RESTRICTIONSSee Attached NIH Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of \$500 or 125% of approved proposal budget category.

Equipment: Title vests with GITCOMMENTS:COPIES TO:SPONSOR'S I. D. NO. 02.108.001.86.007Project Director
Research Administrative Network
Research Property Management
AccountingProcurement/GTRI Supply Services
Research Security Services
Reports Coordinator (OCA)*
Research Communications (2)GTRC
Library
Project File
Other A. Jones

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date8/13/87

Project No.E-18-626

SchoolID#Materials Engineering

Includes Subproject No.(s)N/A

Project Director(s)Dr. Miroslav I. Marek

GTRC /~~XXX~~

SponsorDHHS/PHS/NIH/NIDR

TitleDissolution Of Mercury from Dental Amalgams

Effective Completion Date:7/31/87

(Performance)9/30/87

(Reports)

Grant/Contract Closeout Actions Remaining:

- ☐ None
- ☒ Final Invoice or Final Fiscal Report
- ☐ Closing Documents
- ☐ Final Report of Inventions
- ☐ Govt. Property Inventory & Related Certificate
- ☐ Classified Material Certificate
- ☐ Other

Continues Project No.

Continued by Project No.E-18-640

COPIES TO:

- Project Director

Research Administrative Network

Research Property Management

Accounting

Procurement/GTRI Supply Services

Research Security Services

Reports Coordinator (OCA)

Legal Services
- Library

GTRC

~~XXXXXXXXXXXXXXXXXXXX~~

Project File

OtherAngela D.

Duane H.

Russ E.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE

REVIEW GROUP OBM -2 (AHR-2)	TYPE 5	ACTIVITY R01	GRANT NUMBER (Insert on all pages) DE07754-02
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APPLICATION
FOR CONTINUATION GRANT

TOTAL PROJECT PERIOD

From: **08/01/86** Through: **07/31/89**

REQUESTED BUDGET PERIOD

From: **08/01/87** Through: **07/31/88**

To Be Verified By Applicant. Check Information in Items 1 Through 6. If Incorrect, Furnish Correct Information in Item 13.

1. TITLE

DISSOLUTION OF MERCURY FROM DENTAL AMALGAMS

2a. PRINCIPAL INVESTIGATOR OR PROGRAM DIRECTOR
(name and address, street, city, state, zip code)

MAREK, MIROSLAV I
GEORGIA INST OF TECHNOLOGY
SCH OF MATERIALS ENGINEERING
ATLANTA, GA 30332-0245

4. APPLICANT ORGANIZATION (name and address, street, city, state, zip code)

GEORGIA TECH RESEARCH CORP
GEORGIA INST OF TECHNOLOGY
ATLANTA, GA 30332-0420

5. ENTITY IDENTIFICATION NUMBER

1580603146A12b. DEPARTMENT, SERVICE, LABORATORY OR EQUIVALENT
SCH OF MATERIALS ENGINEERING

2c. MAJOR SUBDIVISION

COLLEGE OF ENGINEERING3. ORGANIZATIONAL COMPONENT TO RECEIVE CREDIT FOR
BIOMEDICAL RESEARCH SUPPORT GRANT (see instructions)**20 OTHER**6. TITLE AND ADDRESS OF OFFICIAL IN BUSINESS OFFICE
OF APPLICANT ORGANIZATION

CONTRACTING OFFICER
GEORGIA TECH RESEARCH CORP
GEORGIA INSTITUTE OF GEORGIA
ATLANTA, GA 30332-0420

COMPLETE THE FOLLOWING (See Instructions)

7. HUMAN SUBJECTS

☒ NO ☐ YES { OR Exemption # _____
Form HHS 596 enclosed

8. RECOMBINANT DNA

☒ NO ☐ YES

9. PERFORMANCE SITES(S) (organizations and addresses)

Georgia Institute of Technology
School of Materials Engineering
Atlanta, Georgia 30332-0245

11. INVENTIONS (see instructions)

☒ NO ☐ YES { ☐ Previously reported
OR ☐ Not previously reported

TELEPHONE INFORMATION

12a. PRINCIPAL INVESTIGATOR OR PROGRAM DIRECTOR (Item 2a)	AREA CODE	TELEPHONE NO. AND EXTENSION
	404	894-2380
12b. NAME OF BUSINESS OFFICIAL (Item 6) R. Dennis Farmer	404	894-4817
12c. NAME AND TITLE OF OFFICIAL SIGNING FOR APPLICANT ORGANIZATION (Item 15) R. Dennis Farmer Contracting Officer	404	894-4817

10. DIRECT COSTS REQUESTED FOR BUDGET PERIOD

\$92,595

13. USE THIS SPACE FOR CORRECTIONS TO ITEMS 1 THROUGH 6. INDICATE THE NUMBER(S) WHERE ANSWER(S) APPLY.

5/26/87 (Mat. Eng) SM
cc: M. I. Marek W. M. Sangster
S. Amblovich PID
E. Thornton

14. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR ASSURANCE: I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if a grant is awarded as a result of this application. Willful provision of false information is a criminal offense (U.S. Code, Title 18, Section 1001).

SIGNATURE OF PERSON NAMED IN 2a. (In ink.
"Per" _____ acceptable)

DATE

5/25/87

15. CERTIFICATION AND ACCEPTANCE: I certify that the statements herein are true and complete to the best of my knowledge, and accept the obligation to comply with the Public Health Service terms and conditions if a grant is awarded as the result of this application. A willfully false certification is a criminal offense (U.S. Code, Title 18, Section 1001).

SIGNATURE OF PERSON NAMED IN 12c. (In ink.
"Per" signature not acceptable)

DATE

5/26/87

RETURN COMPLETED APPLICATION TO PHS AS SOON AS POSSIBLE:
NO LATER THAN **1 JUN 1987**

SECTION I (continued)
SUMMARY OF PROPOSED WORK

GRANT NUMBER
DE07754-02

KEY PROFESSIONAL PERSONNEL ENGAGED ON PROJECT

NAME	POSITION TITLE	DEPARTMENT AND ORGANIZATION
Miroslav I. Marek	Professor	School of Materials Eng., Georgia Tech
Eva Topfl	Research Technician	School of Materials Eng., Georgia Tech

Give a brief summary of plans for the next year of support, including the objectives and specific aims as well as the methodology to be used to achieve these aims. DO NOT EXCEED THE SPACE PROVIDED.

The objective of the research project is to identify factors that control the release of mercury from dental amalgam, and to determine the quantitative relationships between the variables and the mercury release rate. In this project period the research will have the following specific aims:

1. To develop the procedure for the determination of the fundamental rate constants for mercury dissolution, and to determine these constants for mercury dissolution from the silver-mercury phase as a function of the phase composition.
2. To determine the effect of the electrode potential on mercury dissolution, and determine the reactions between ionized and nonionized mercury forms.
3. To examine simultaneous dissolution/evaporation and determine which process is rate controlling under conditions relevant to those in the oral cavity.

Samples of the silver-mercury phase will be exposed to synthetic saliva at body temperature. The total dissolved mercury will be determined by cold-vapor atomic absorption spectrophotometry. The ionized forms of mercury will be detected by electrochemical techniques. The effect of the electrode potential on the rate of mercury dissolution will be determined. Mercury evaporation will be monitored using a gold-foil mercury detector.

VERTEBRATE ANIMALS INVOLVED ☒ NO ☐ YES If "YES," identify by common names and underline primates.

SECTION IV PROGRESS REPORT SUMMARY		GRANT NUMBER DE07754-02	
PRINCIPAL INVESTIGATOR OR PROGRAM DIRECTOR MAREK, MIROSLAV I.		PERIOD COVERED BY THIS REPORT	
NAME OF ORGANIZATION Georgia Tech Research Corp. Georgia Institute of Technology		FROM 08/01/87	THROUGH 07/31/88
TITLE (Repeat title shown in item 1 on first page) DISSOLUTION OF MERCURY FROM DENTAL AMALGAMS			
(SEE INSTRUCTIONS)			

PUBLICATIONS

M. Marek: Dissolution and Evaporation of Mercury from Dental Amalgam. IADR/DMG Microfilm, 1987 General Session of the IADR.

E. Euvrard: Dissolution and Evaporation of Mercury from Aqueous Solutions. M.S. Thesis, Georgia Institute of Technology, 1987.

REPORT

General Scientific Goals

The goals remain the same, i.e., to identify factors that control the release of mercury from dental amalgam, and to determine the quantitative relationship between the variables and the mercury release rate.

Studies Performed

In the first program year the main emphasis was on the determination of the mechanism of the mercury release relevant to oral conditions. Mercury can evaporate or dissolve, dissolution being possible in either ionized or non-ionized forms. A series of experiments was performed to examine these fundamental questions.

In the dissolution experiments, the release of mercury from the silver-mercury phase (major Hg-containing phase in dental amalgam) into synthetic saliva was measured as a function of time of exposure, using Atomic Absorption Spectrophotometry (AAS) as analytical technique. The rate of dissolution appeared to decrease with time, as reported by other researchers. In more detailed tests it was found, however, that the major factor in the decrease was the increase in the mercury content in the test container. Since the solubility limit for mercury in aqueous media is low, even low concentrations of dissolved mercury severely slowed down the further release. Tests with different test volumes and liquids in which the solubility of mercury was different confirmed the importance of the concentration, which has been neglected in previously published reports. This finding opens the way to the determination of the fundamental release rate constants, which will be the focal point of measurements in the next program period.

In the first set of evaporation tests the loss of mercury from a solution in synthetic saliva was measured by analyzing the solution by AAS as a function of time without dissolving more mercury. It was found that mercury evaporated at a high rate when reduced to the nonionized form, the rate being a function of the remaining concentration of non-ionized mercury. When mercury was in the ionized form the evaporation was slow and apparently controlled by the rate of the disproportionation reaction which results in the formation of non-ionized mercury.

MAREK, MIROSLAV I.

Georgia Tech Research Corp.
Georgia Institute of Technology

08/01/87

07/31/88

DISSOLUTION OF MERCURY FROM DENTAL AMALGAMS

These results will focus the attention in the next program period on the rate of the disproportionation reaction which may, in some cases, control the rate of evaporation

In the second set of evaporation tests mercury was dissolved in deoxygenated water of various purity, and the loss from the solution was analyzed by AAS as a function of time. It was found that the water quality had a substantial effect on the evaporation rate variation with time. By using sterilized and nonsterilized water as well as bacteriocidal agents the differences were found to be due to the presence of bacteria in some of the media, the bacteria apparently transforming mercury ions into the volatile mercury forms.

The analysis of the results obtained in the first program years shows that the major form of release of mercury from dental amalgam under oral conditions is mercury dissolution into the oral liquid followed by evaporation into the oral atmosphere. The presence of oral bacteria may accelerate the evaporation process. To measure the release rate it is necessary to take into account the strong effect of mercury concentration on the rate of dissolution. The determination of fundamental rate constants will make possible to compare the release rates from different materials. The results to date point to the solid-liquid interface reactions as being most likely rate controlling. The evaporation and disproportionation, however, cannot be discounted; the results to date show the rates to be lower than the rate of the interface reaction, but on the same order of magnitude.

While all objectives for the first year have been met, it was found that the lack of facilities for simultaneous measurement of dissolution and evaporation impeded the work. This will be corrected by the acquisition of the mercury vapor analyzer.

Objectives for the coming year

1. To develop the procedure for the determination of the fundamental rate constants for mercury dissolution, and to determine these constants for mercury dissolution from the silver-mercury phase as a function of the phase composition.
2. To determine the effect of the electrode potential on mercury dissolution, and determine the reactions between ionized and nonionized mercury forms.
3. To examine simultaneous dissolution/evaporation and determine which process is rate controlling under conditions relevant to those in the oral cavity.