Monthly Status Report • December 2010
Covering the Period 1 December through 31 December 2010

POWER MEMS DEVELOPMENT

Contract N00014-09-C-0252
Submitted in accordance with Deliverable A001 - Monthly Technical and Financial
SRI Project P19063

Prepared by:
Andrew Hanser, PhD, Program Manager
John Bumgarner, PhD, Director
MicroScience Engineering Laboratories
Physical Sciences Division

Sponsored by:

Office of Naval Research
Code 331
875 North Randolph Street
Arlington, Virginia 22203

Distribution:

Dr. Terry Ericsen, COTR
Mr. Mariano Knox, ACO
Distribution: “A”

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JAN 2011		**00-00-2011 to 00-00-2011**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Power Mems Development	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **SRI International,333 Ravenswood Ave,Menlo Park,CA,94025**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**4**	

MICROELECTROMECHANICAL SYSTEM (MEMS) RESETTABLE CIRCUIT BREAKER (TASK 1.1) AND MEMS SWITCH FOR DC-DC VOLTAGE CONVERTERS (TASK 1.2)

Task 1.1 Contributors: Sunny Kedia, Weidong Wang, Susana Stillwell

Task 1.1 Deliverable: 10 prototype packed MEMS-based resettable circuit breakers for testing and analysis in the Office of Naval Research (ONR) laboratories.

Task 1.2 Contributors: Sunny Kedia, Shinzo Onishi, Scott Samson, Drew Hanser

Task 1.2 Deliverable: Functional MEMS-based DC-DC converter in a vacuum package.

Summary: This month in Task 1.1, we processed wafers with the revised Metal 3 and Dielectric masks. We completed the processing of the double-side-polished (DSP) wafer; however, the silicon-on-insulator (SOI) wafer is on hold due to deep reactive ion etching (DRIE) processing issues.

In Task 1.2, we processed wafers with the new pre-sputter metal deposition process. We diced chips from these wafers and released them using both using hydrogen fluoride (HF) and buffered-oxide-etch (BOE) processes. The metals were unaffected in both processes. We then flip-chip bonded the chips and tested the device for switch operation. During testing, we found that all of the actuating silicon (Si) structures that were tested moved toward the Si substrate instead of the glass electrode and remained stuck to the Si substrate. Further analysis showed switches that were not tested remained released, indicating this occurred as a result of the testing. These data suggest that during testing there is an electric potential established between the plate and the Si substrate that allows the plate to move toward the substrate instead of the electrode on the glass substrate. A 1-µm gap between the plate and the substrate allows a small potential to move the plate toward the substrate. We believe this potential occurs due to large contact resistance between the metal contact pad and the substrate, resulting in a voltage at the substrate that is sufficiently large to move the plate.

To address this issue, we are designing a mask to etch the Si substrate in the vicinity of the plate to eliminate the substrate potential below the plate.

DIAMOND HEAT SPREADER OR HEAT SINK FOR HIGH-POWER MEMS SWITCH APPLICATIONS (TASK 1.3)

Contributors: Priscila Spagnol, Shinzo Onishi, Drew Hanser, Weidong Wang, Sunny Kedia, John Bumgarner

Deliverable: Prototype device fabricated on a thin-film diamond heat spreader layer and individual samples of diamond on Si or other suitable substrates for material evaluation.

Summary: No work was done this month on Task 1.3.

POSITRON TRAPPING AND STORAGE (TASK 2)

Contributors: Ashish Chaudhary, Friso van Amerom, Tim Short

Deliverable: A minimum of four MEMS-based trap structures for radio frequency (RF) trapping of electrons.

Summary: We assembled the test set-up using the new aluminum (Al) flanges to shield high voltages and repeated experiments to determine if electrons were trapped.

To improve the injection efficiency of the electrons in the trap, a 180° out-of-phase RF potential was generated using a balun and applied to the opposite RF electrodes. A pulsed scheme was used on both Mesh 1 and Endcap 1 to slow the electrons down. We varied the biasing at the electron source microchannel plate (MCP) backside from 0 to 15 volts to shift the energy of the generated electrons. No signal was observed that would indicate trapping of electrons.

FINANCIAL STATUS

R&D Status Report

Program Financial Status

15 July 2009 through 1 January 2011

Contract Item No.	Current Funding	Current Period Expenses	Cumulative Expenses	% Budget Complete
0001	$1,829,849	$30,545	$1,571,596	86%
Project Commitments		(2,059)	211,875	
Total	$1,829,849	$28,486	$1,783,471	

Based on currently authorized work:

Is current funding sufficient for the current fiscal year (FY)? (Explain if NO) **Yes**

What is the next FY funding requirement at current anticipated levels **N/A** (**base fully funded)**