REPORT DOCUMENTATION PAGE

Form Approved
OMB NO. 0704-0188

1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE -September 17, 2002	3. REPORT TYPE AND DATES COVERED Final Report (May 27 to Aug 27, 2002)

4. TITLE AND SUBTITLE
Innovative, High-Throughput, Large-Area, Versatile Nanoimprint Tools

5. FUNDING NUMBERS
DAAH01-02-C-R059

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10. SPONSORING / MONITORING AGENCY REPORT NUMBER

A002

11. SUPPLEMENTARY NOTES
The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by the documentation.

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

12 b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Nanonex is successfully finishing the SBIR Phase-I project and has developed a unique nanoimprint tool, Voyager-I. The tool offers unprecedented fast operation (<60 sec per wafer) and excellent nanostructure uniformity over large area (>4"). Furthermore, Voyager is well suited for precision alignment.

14. SUBJECT TERMS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OR REPORT	18. SECURITY CLASSIFICATION ON THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

Enclosure 1

Status Report

"Innovative, High-Throughput, Large-Area, Versatile Nanoimprint Tools"

September 18, 2002

Sponsored by

Defense Advanced Research Projects Agency (DOD
Ccontrolling DARPA Office)

ARPA Order K475/39

Issued by US Army Aviation and Missle Command Under

Contract No. DAAH01-02-C-R059

Effective Date of Contract: 31-Oct-2001
Contract Expiration Date: 26-June-2002

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Short Title of Work: Final Report

Reporting Period: 31-Oct-2001 to 26-June-2002

Under the SBIR Phase-I, Nanonex has redesigned the TOM machines to achieve a user-friendly commercial NIL machine, which is named Voyager-I. The Voyager-I was designed for large wafers size (>6"), large imprint-area-uniformity, and high throughput (sub-minute imprint cycle).

The redesign involves (i) optimization "conformal press" design and process (e.g. gas injection methods and the choices of different gases), for improving the imprint-area-uniformity and the throughput. (ii) Study of optimum lamp heater design and process that can improve the imprint-area- uniformity and the throughput. (iii) Study of optimum cooling design and process that can improve the imprint-area- uniformity and the throughput. (iv) Study of the optimum processes for high throughput NIL by investigation of different temperatures and duration in heating and cooling. (v) Study of optimum machine chamber design that can allow a single machine to perform different NIL methods: from deep 3D imprint in thermal plastic to imprint using uv (or thermal) curable polymers. (vi) Study of the scaling of the new design to large wafers (>6" diameter).

Through the Phase-I, Nanonex has built an alpha-tool of Voyager-I, which is currently being used by a commercial company doing manufacturing of integrated optical devices. As shown in Fig. 1, the alpha-tool of Voyager-I is very compact. It has a foot-print of 26in (length) x 24in (width) x 42in (height). Voyager-I has sub-10 sec cycle for each step (heating, pressing, etc) and a total cycle time less than one minute, as indicated by the temperature and press curves in Fig. 2.

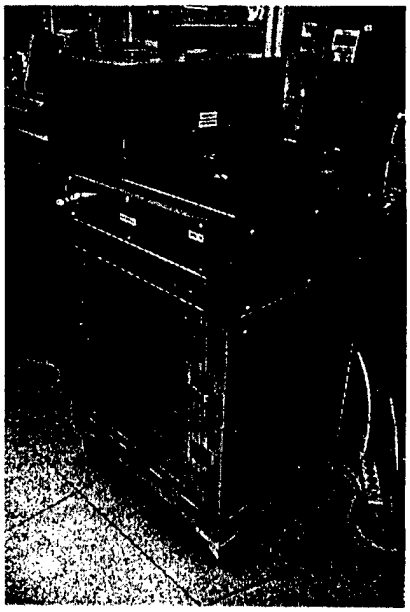

Fig. 1. An alpha tool of Voyager-I, which is being used by a commercial company for manufacturing.

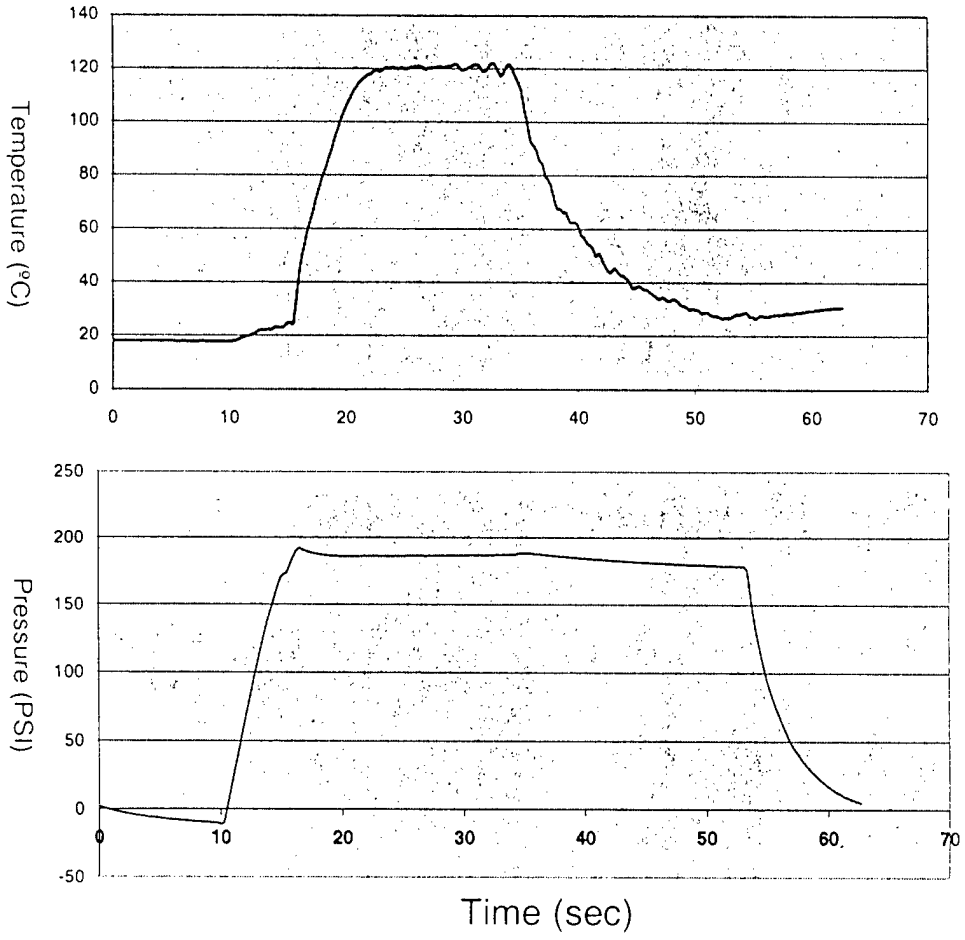

Fig. 2. The change of the temperature and pressure during an imprint cycle, showing a 10 sec for pumping down, 10 sec for ramping the pressure from 0 to 190 psi, 10 sec for heating up from 20 C to 120 C, 15 sec for imprint, and 25 sec for cooling from 120 C to 28 C. The total NIL time without pumping is 55 sec and 65 sec with pumping.

Enclosure 2