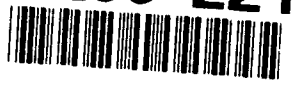

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Final Technical Report

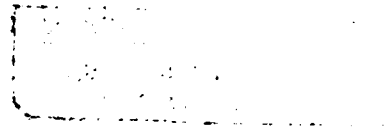
Office of Naval Research

Grant No. NOO014-87-K-0354

10-1-89

Writing with Atoms

M. H. Nayfeh, Principal Investigator
Department of Physics
1110 W. Green Street
University of Illinois-Urbana/Champaign
Urbana, IL 61801



This is a final technical report of the ONR grant NOO014-87-K-0354 covering the period May 15, 1987 - October 1, 1989. This is the first phase of the on going project of writing with atoms.

These are the tasks that have been accomplished:

A) Purchase of Equipment

The procedure involved a process of identifying needs and specifications, sending out price requests and securing bids. Following is the equipment we purchased.

- -STM head and control unit
- -Personal Computer, monitor, laser printer
- -Vibration free platform
- -Ion pump, turbo pump, vacuum components
- -Excimer laser, two dye lasers, optics

B) Construction of Facilities

1) Construction of an ultra high vacuum (UHV) system that provides a pressure of 10^{-9} Torr, and construction of a high pressure module that is coupled to it (this module houses the STM head). This module provides regulated flow or static fills using a gas handling system.
2) The facilities (power, cooling, gas, exhaust, etc.) needed for the laser operation were furnished. The excimer laser and the two dye lasers were then installed and made operational.
3) The STM system was installed on the vibration free system and put into operation.
4) A multiphoton ionization chamber for laser spectroscopy of the precurser gasses was constructed. The chamber contains a charge particle detector, amplifiers, biasing supplies, and a vacuum and gas handling system.

C) Testing and Preparations of Individual Facilities

1) The STM system was first tested in air using graphite samples and then under ultra high vacuum conditions. Atomic resolution in air and in UHV was achieved.
2) The excimer laser was tested and used to pump the dye lasers, operated with appropriate dyes that provide radiation wavelengths within the absorption spectrum of trimethyl aluminum (TMA).
3) The photodissociation and multiphoton ionization spectrum of TMA was recorded using the ionization chamber facility. The lasers were then tuned to an absorption line that maximizes selective production of aluminum ions from TMA.

D) Integration of the Individual Facilities into One Working Facility.

After the preparation and testing of individual facilities, a full integration was carried out. The STM was housed in the vacuum chamber, the gasses were delivered, and an optical system was put in place allowing the delivery of the radiation to the tunneling gap. A scheme for aligning and focussing the laser beams onto the gap was developed. The scheme utilizes an optical microscope, a T.V. camera, and a CRT screen.

Although the system was in full operation towards the end of this period, the actual demonstration of the writing was carried out at the beginning of the second period which started October 1, 1989.