Ravikiran Attota Group
NIST
Silver Medal
Scientific/Engineering Achievement

Nominee Information:

Salutation (Ms., Mr., etc.) [Select from Drop Down]	**Nominee Name (or Organization Name)**	**Bureau, First Subdivision** (Ex. – NOAA, National Weather Service)	**Position Title**	**Pay Plan, Series, and Grade**	**Nominee is Eligible Based on Current Rating of Record** (Yes or No; select from Drop Down)	**Past Awards** (Honor or high-level awards received in last 5 years; do not include Special Act or Cash-In-Your- Account Awards)
Dr.	Ravikiran Attota	NIST/MEL	Mechanical Engineer	ZP-0830-IV	Yes	None
Dr.	Richard Silver	NIST/MEL	Supervisory Physicist	ZP-1310-V	Yes	Silver Medal 2003, Silver Medal 2004, Nano 50 award 2007
Mr.	Michael Stocker	NIST/MEL	Electronics Technician	ZT-0856-IV	Yes	None

The Department of Commerce limits group nominations to 10 members and joint organizational nominations to 3 organizational units.

☒ **As the nominator, I certify, through checking the box to the left of this statement, that the nominee(s) listed above have a minimum current rating of record of Level 4 or higher; Commendable or higher; Eligible (Demo); or Meets or Exceeds Expectations (Two-Level).** *If any nominee has a current rating of record of Level 3 or Fully Successful, a separate, one-page justification which details the specific reasons why the award is recommended must be attached to this nomination.*

Nominator's Name and Phone Number: Dr. Howard Harary 301-975-3400

Medal Type (select Gold or Silver from drop-down): Silver

Nomination Type (select one from drop-down): Group

Category (select one from drop-down): Scientific/Engineering Achievement

What is the significance of this accomplishment? *(Maximum of 200 characters)*

This question is designed to give an overview of the importance of the contribution. The response should focus on the value of the accomplishment in concrete, results-oriented terms.

Changing the way the semiconductor industry does overlay metrology with new optical designs, in-chip targets, and wafer standards, enabling the production of circuits with ten times greater density.

Describe how this accomplishment exceeds the performance expectations of the individual(s) or organization(s). (*Maximum of 300 characters)*

Use this section to provide a compelling statement describing how the nominee exceeded performance expectations as opposed to merely doing his or her job. Please note, while exceeding a performance metric and contributing to the accomplishment of the Department's organizational mission and strategic goals is laudable, it does not necessarily evidence exceptional work above that which would have been expected by the nominee in the normal course of his or her job. The impact of the nominee's accomplishment must be truly exceptional and reflect only the highest level of achievement in the Department.

In developing measurement standards in support of the semiconductor manufacturing industry, the nominees exceeded expectations by inventing new techniques that are revolutionizing how the industry builds its measurement instruments and reference structures in this critical metrology area.

I. Certificate Citation: *(Maximum of 150 characters)*

The certificate citation must begin with the word, "*For*" followed by a statement, which summarizes the accomplishment. (Example - For developing a technique to estimate current and historic rates of natural gas flaring through an effective use of satellite imagery data.)

For major innovations in semiconductor overlay metrology hardware and target designs, allowing processors and memory with ten times greater density.

II. Program Booklet Citation: *(Minimum of 450 characters, maximum of 600 characters)*

The program booklet citation must adhere to the following format. Individual nominations (*Mr. Smith is recognized for*…); Group nominations (*The group is recognized for*…); Organizational awards (*The organization is recognized for*…). In lieu of "recognized for", the following may also be used, "*honored for*" or "*cited for*". The program booklet must begin with one of the above introductory phrases, which clearly states what is being recognized followed by details on the nominee's work, and conclude with a sentence on the impact or importance of the accomplishment.

The group is recognized for transformational advances in semiconductor overlay metrology. Achievements include the first calibrated overlay standards used to develop reference metrology at the Semiconductor Manufacturing Technology consortium (SEMATECH) and to improve metrology tool uniformity in industry. The researchers pioneered widely used in-chip overlay targets and invented sub-resolution supertarget technology, supported by fundamental optical microscope design changes. These innovations will enable ten times greater density in processor and memory chips at the 45 nm node and beyond.

III. Justification:

The following questions are designed to succinctly clarify the nominee's accomplishment(s) and the reasons this nomination merits either a Gold or Silver Medal. The justification should be concise and clear, written in "Plain English," and should not rely on acronyms, jargon or extremely technical text. In addition, the justification should be written for the lay reader, not an expert in the field. Complicated technical descriptions often serve to confuse the reader and are seldom necessary to describe the accomplishment. Complete nominations must include responses to Section 1, if applicable, and to both Sections 2 and 3.

Section 1 – Definitions (*Maximum of 500 characters)*

Use this section to define all scientific/technical terms, acronyms, or terms-of-art whose meanings are not readily apparent to a lay reader. This section is only for the definition of terms used in the justification below. Do not define terms in common use within the Department, such as ITA, DOC, OPM, etc.

Overlay metrology is the measurement of registration from one photolithographic level to another used in semiconductor manufacturing. The alignment must be exact as the circuits are built level by level. The targets are the fiducial marks used for alignment. In-chip overlay targets were the first high-proximity targets capable of being printed within the active chip area. Supertargets are a revolutionary design allowing optical image-based overlay measurements of fully sub-resolution features.

Section 2 - Award Justification *(Maximum number of characters for all four questions in this section cannot exceed 2000)*

1. **What was the specific goal, challenge or problem related to the Department's mission and/or strategic plan?**

The challenge was to develop the essential overlay metrology standards and methods to enable future generations in US semiconductor manufacturing. Existing overlay targets were too large to be placed in the critical in-chip active areas. Simple down-scaling the target size would make them too small for accurate optics-based registration measurements. Major hardware and target innovations were needed.

2. **What was the context in which the nominee addressed the goal, challenge or problem?**

The nominees worked on NIST and industry funded research efforts to advance overlay metrology. They worked closely with SEMATECH, the semiconductor manufacturer consortium, and with leading optical instrument makers to help them adopt and implement NIST-developed techniques and standards.

3. **What specific actions did the nominee take to address the goal, challenge or problem?**

The nominees developed advanced optical instrument designs and overlay targets to enable ground-breaking methods for overlay metrology, resulting in many significant publications. The methods are now being widely adopted by the semiconductor industry. The group invented overlay targets having sub-optical-resolution patterns. These supertargets can be examined using microscopes having innovative structured illumination to enable the measurement of overlay registration with unprecedented resolution and accuracy. Placement of these supertargets within

the active chip area allows the measurement of in-chip field distortions. This otherwise unobtainable information is increasingly critical for making higher density patterns.

4. What were the results of the actions in either quantifiable or qualitative terms?

In-chip targets and structured illumination designs based on NIST research are now used by several leading manufacturers and optical instrument makers. SRM 5000, the only overlay standard available, is used by SEMATECH and leading manufacturers for reference measurement systems. These methods and reference standards enable the increasingly difficult overlay metrology requirements to be met. This is critical for keeping the industry on the innovative path that enables current and future generations of increasingly dense and complex circuits with maximum economic impact.

Section 3 - Additional Information *(Maximum number of characters for all six questions in this section cannot exceed 2000)*

1. How long did it take to complete the accomplishment? When was the accomplishment completed/implemented/deployed?

This accomplishment represents eight years of sustained effort in overlay metrology innovation. Novel hardware and data acquisition techniques have been developed including video camera scale calibration, and target symmetry and reversal techniques. Initial in-chip designs were introduced five years ago and are currently used by several chip makers with leading optical overlay instruments. The SRM 5000 calibrated overlay wafer was released two years ago, and is the fundamental standard being used to develop integrated reference metrology and optical tool set calibration and matching at SEMATECH and at leading US manufacturers. The NIST-developed overlay technology has been introduced as a core design element in the current generation of leading optical overlay metrology instruments.

2. What is the short-term impact (1-2 years) of the accomplishment on the bureau and/or Department's mission?

US semiconductor industry innovation has been enabled, leading to faster and cheaper processor and memory chips. The importance of this work is increasing because of recent substantial tightening of overlay manufacturing tolerances due to new semiconductor lithography techniques, e.g., double patterning. US optical metrology instrument makers and instrumentation users have a direct benefit in increased sales and fabrication productivity from these NIST-led advances.

3. What is the long-term impact (3-5 years) of the accomplishment on the bureau and/or Department's mission?

The innovative techniques introduced by this work have created new methodologies for overlay metrology which are now forming the basis for further advances. This seminal work will therefore continue to have significant importance and impact for future generations of US semiconductor manufacturing technology.

4. **Does the accomplishment affect other bureaus/Department or other Federal agencies? If so, how?**

Not directly.

5. **Did the accomplishment result in a major advancement in science, technology, or automation? If so, how?**

Eager adoption of these innovative techniques by the highly competitive US semiconductor industry demonstrates the importance of the advances. The new structured-illumination methods for improved overlay metrology instrument performance along with the new supertarget designs based on sub-resolution superstructures represent ground-breaking advances in the science and technology of overlay metrology.

6. **Did the accomplishment result in a major advancement in non-scientific areas such as customer service or administrative support? If so, how?**

No.