Project Title: Nanomechanical detection of plasma and materials processes

Project Reference Code: Camata-UAB

Name of Project Leader: Renato P. Camata

Host Facility: University of Alabama at Birmingham

Internship Location: University of Alabama at Birmingham

Host Facility Location: 1720 2nd Ave South, Birmingham, AL 35294

Project Description (roughly 300 words):
Low-temperature plasmas are routinely used to clean, etch, chemically alter, and coat materials surfaces. A rich variety of physical and chemical processes mediate the effects of these plasmas on materials. Condensation and evaporation of atomic species on a surface are just two examples of phenomena that can be manipulated by a remote plasma to alter a material. These alterations permit studies of the fundamental properties of the plasma/materials interface as well as creation of new sensing and nanofabrication technologies. In this project, the student will use nanomechanical effects in a thin film material as a probe for plasma and materials transformations. The student will learn how to operate numerous instruments including lasers, optical sensors, vacuum systems, power supplies, and plasma generation equipment. Data analysis will include modeling of nanomechanical phenomena using Python programs developed in our research group. The student will learn how to use these programs to extract information on the physics of the experiments.

Disciplines: Applied Physics, Physics, Chemistry, Engineering, Electrical Engineering, Materials Science and Engineering, Mechanical Engineering, Chemical Engineering, Computer Science, Electrical and Computer Engineering

Importance:
Nanomechanical sensors are ubiquitous in advanced technology and modern consumer products. From airbag deployment systems to accelerometers in smart phones, being familiar with the physics of these devices is becoming increasingly important in STEM. It is also essential to master the operation of technical instruments and the use of algorithms to analyze data from in-situ diagnostics. These skills are in high demand both in the workforce and in plasma and materials research.

Requirements:

- **Preferred Major**
  - All STEM majors eligible. Physics, engineering, and computer science majors preferred.
- **Class work**
  - Calculus-based introductory physics required. Upper division physics courses preferred.
- **Programming knowledge**
  - Prior knowledge of programming not required. Working knowledge of Python programming preferred.
- **Software knowledge**
  - Fluency in standard software for graphing and basic calculations required.

- **Other**

Biography (roughly 100-150 words):
Renato Camata received his Ph.D. in Applied Physics from the California Institute of Technology. As an undergraduate physics major, he discovered that the same beauty we apprehend in cosmology and the theory of general relativity, is close at hand in the everyday world of atoms and in how they combine to form the modern materials of solar cells and touchscreens. It was through an undergraduate research project that he learned to locate, inside a crystal, tiny amounts of dopant atoms responsible for the essential properties of the devices in today's computer chips. In his current research, Camata applies plasma processes in the synthesis of quantum materials—compounds that have potential for significant societal and economic impact. In addition to training 9 PhD scientists and 11 MS thesis-level projects, Camata has mentored 78 undergraduates in research activities, while leading an independent research program funded by NSF, NASA, DOD, and industry.

Is U.S. citizenship required to participate in this project? No

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