The Role of Surface Roughness on Ion Sputtering Yield Measurements

Katie Grundy, Purdue University; Norris W. Watkins II, Tuskegee University; Al-Montaser BA Al-Ajlony, Purdue University; Theodore J. Novakowski, Purdue University; Mark Catalfano, Purdue University; Jitendra K. Tripathi, Purdue University; Sivanandan Harilal, Purdue University; and Ahmed Hassanein, Purdue University

Ion sputtering is the removal of surface atoms or molecules in a solid under energetic ion irradiation. This technique is promising for its applications in material modification and characterization. Sputtering yield, the average number of atoms removed from a sample per incident ion, is a crucial parameter in material modification. In the present study, a quartz crystal microbalance was used within an ultra-high vacuum chamber (10E-8 torr) to measure the sputtering yield of gold. An NTI-1401 ion gun was used to bombard argon and helium ions onto a gold sample. The argon and helium ions used ranged in energy from 100 – 5000 eV. Theoretical sputtering yield values were determined through simulation with Stopping and Range of Ions in Matter (SRIM) software and compared with experimentally measured values. The experimental values show a significantly higher sputtering yield for gold than that of the SRIM values; however they followed the same trend. Another observation was that for a constant ion energy bombardment the sputtering yield decreased with time. An atomic force microscopy (AFM) was performed before and after sputtering. The AFM showed that the surface of the sample became smoother after a period of ion bombardment. These observations suggest that surface topography significantly affects the sputtering yield values. The reasoning behind the discrepancy between experimental and SRIM sputtering yield values will be discussed.