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A Magnetron Sputter Deposition System for the Development of X-ray Multilayer Optics

Project Manager(s)/Lead(s)

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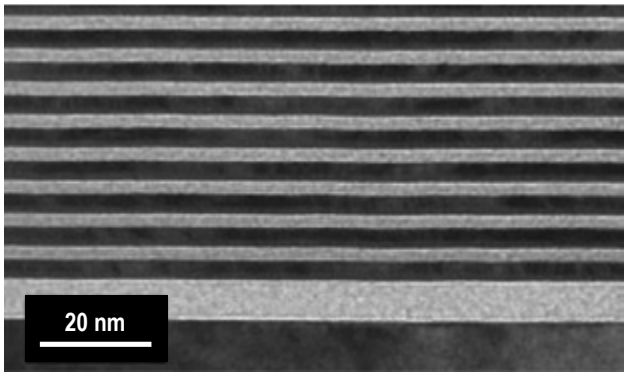
Sponsoring Program(s)

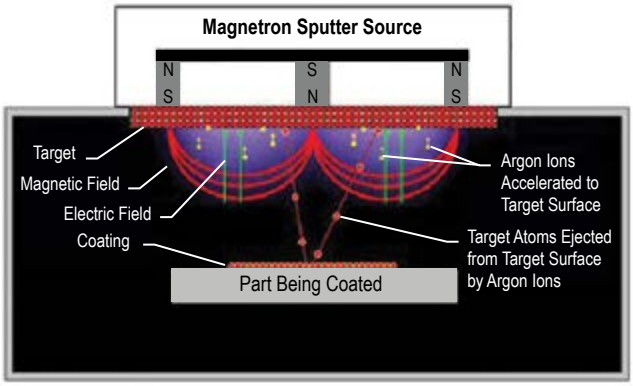
Space Technology Mission Directorate
Center Innovation Fund

Project Description

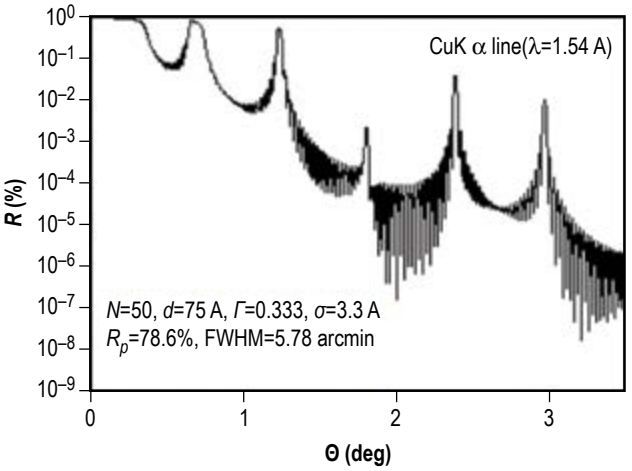
The project objective is to establish the capability to deposit multilayer structures for x-ray, neutron, and extreme ultraviolet (EUV) optic applications through the development of a magnetron sputtering deposition system. A specific goal of this endeavor is to combine multilayer deposition technology with the replication process in order to enhance NASA Marshall Space Flight Center's (MSFC's) position as a world leader in the design of innovative x-ray instrumentation through the development of full shell replicated multilayer optics. The development of multilayer structures are absolutely necessary in order to advance the field of x-ray astronomy by pushing the limit for observing the universe to ever-increasing photon energies (i.e., up to 200 keV or higher), well beyond Chandra's (~10 keV) and NuStar's (~75 keV) capability. The addition of multilayer technology would significantly enhance the x-ray optics capability at MSFC and allow NASA to maintain its world leadership position in the development, fabrication, and design of innovative x-ray instrumentation, which would be the first of its kind by combining multilayer technology with the mirror replication process. This marriage of these technologies would allow astronomers to see the universe in a new light by pushing to higher energies that are out of reach with today's instruments. To this aim, a magnetron vacuum sputter deposition system for the deposition of novel multilayer thin film x-ray optics is proposed. A significant secondary use of the vacuum deposition system includes the capability to fabricate multilayers for applications in the field of EUV optics for solar physics, neutron optics, and x-ray optics for a broad range of applications including medical imaging.



Transmission electron microscopy image of multilayer structure.



Schematic diagram of the magnetron sputtering process.



Calculated reflectivity from a periodic multilayer structure.

Anticipated Benefits

The ultimate goal is to provide the x-ray astrophysics community with improved instrumentation for the discovery of how the universe works from the very moment of its creation through the evolution of galaxies, stars, and planets, how it will continue to evolve, and what its ultimate fate may be.

This project is specifically related to the following technology theme: x-ray telescope systems and associated technologies.

The activity of this project also stimulates the neutron, EUV, and x-ray instrumentation development in other fields including medical imaging.

Notable Accomplishments

Funding cuts in the first year prohibited the completion of first year goals. However, a vacuum chamber was designed, procured, and received.