NASA SBIR/STTR Technologies

Highly Efficient FUV Photodetector with AlGaN Nanowire Photocathode

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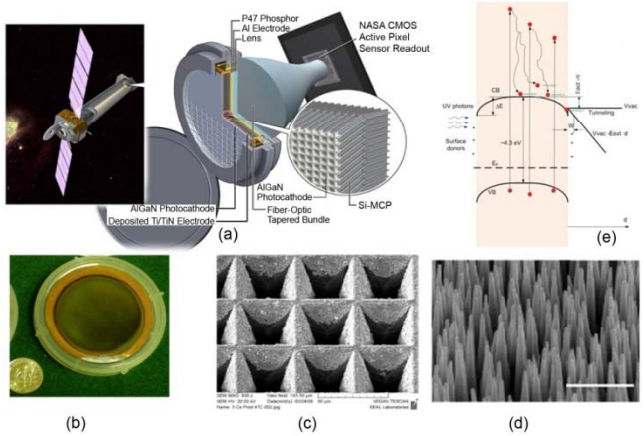
Identification and Significance of Innovation

To address NASA needs for efficient photodetectors for new FUV space instrumentation, Physical Optics Corporation (POC) proposes to develop a new solar-blind, highly efficient photocathode made of Mg-doped AlGaN nanowires (NWs) grown on the entrance surface of a Si-MCP (AlGaN NW-Si-MCP) for UV Silicon Microchannel Plate (Si-MCP) based photodetectors. The photocathode will have quantum efficiency >50% in the UV spectrum, with a sharp cutoff below the visible range. The improvement in photodetector efficiency and its large size will significantly reduce requirements for future space UV telescopes and other mission instrumentation, without sacrificing performance parameters. In Phase I, POC demonstrated the technology of GaN and AlN nanowire growth by Hydride Vapor Phase Epitaxy and investigated properties of nanowire surfaces. At the end of Phase II, the photodetector will reach TRL 5-6 by demonstration of the photodetector operation in high-vacuum.



Application scenario and design of Si-MCP-based windowless photodetector with AlGaN NW-Si-MCP photocathode (a); silicon microchannel plate with AlGaN NW photocathode (b-d); energy bands diagram of AlGaN NW photocathode with Negative Electron Affinity (e).

Technical Objectives

Objective 1.Optimization of the AlGaN NW photocathode design and technology of the photocathode fabrication on flat silicon substrates

Objective 2. Demonstration of the high QE of the NW photocathodes, achievable without photocathode activation by cesiation

Objective 3. Fabrication of AlGaN NW photocathodes on the entrance surfaces of Si-MCPs

Objective 4. Demonstration of the high QE of NW photocathodes grown on the entrance surfaces of Si-MCP substrates

Objective 5. Investigation of uniformity and longevity of NW photocathodes fabricated on the Si-MCP substrates

Objective 6. Identification of commercial potential of the AlGaN NW-Si-MCP devices

Work Plan

1. *Optimize Density and Shape of Nanowires in AlGaN NW Photocathode.*
2. *Investigate the NW Surface Modification Options.*
3. *Optimize NW Nucleation Process on Si/Ti Substrates.*
4. *Optimize NW Growth Technology.*
5. *Develop NW Cleaning Procedure Technology.*
6. *Fabricate Si-MCP Substrates for Deposition of AlGaN NW Photocathode.*
7. *Fabricate AlGaN NW Photocathodes on Si MCP Substrates.*
8. *Investigate Performance Parameters and Longevity of UV Photodetector with AlGaN NW Photocathodes on Si MCP.*
9. *Commercial Potential and Product Viability.*
10. *Prepare and Submit Reports.*

NASA Applications

UV telescopes and spectrometers for future missions for Explorers, Discovery, Origins, Beyond Einstein, and Vision programs. Current and future missions that rely on this technology include HST-STIS, GALEX, COS, EUVE, XMM-OM, CHIPS, and FAUST.

Non-NASA Applications

Missile plume detection, investigation of metabolism in organic cells by monitoring UV fluorescence, atmospheric research, and over the line-of-sight covert communication.

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