



Contribution ID: 80

Type: Poster

High-performance Dichroic Filters Development for Large-Scale Neutrino Detector

Tuesday, 7 November 2023 19:40 (20 minutes)

High performance dichroic filters (DFs) are key photon wavelength sorting devices for Cherenkov and scintillation light in water- and scintillator-based neutrino detectors. Future detectors such as THEIA and DUNE will require large-area DFs at a low cost and with improved transmissivity and reflective properties. DFs are traditionally manufactured by various physical vapor deposition (PVD) techniques such as ion beam sputtering, electron beam and thermal evaporators with ion assistance. However they all have been subject to intrinsic drawbacks of poor large area uniformity, especially on curved surface, poor thickness control and high cost associated with vacuum technology and thickness monitoring tools. Atomic layer deposition (ALD) on the other hand has been well established for precise thickness control, excellent large area uniformity and conformity for coatings on complex surfaces, and low growth temperatures. Therefore it is well suited for optical coatings on large area glass tiles or temperature sensitive plastics, and on curved surfaces of Winston cones. In addition, a wide range of high quality dielectric materials (oxides, nitrides, fluorides, carbides, etc.) with high, medium and low refractive indexes are available by ALD, most of which can be deposited in a single ALD chamber thus complexity and production cost can be reduced. These merits provide an excellent solution to manufacturing various bandpass DFs requiring tight specs for multiple dielectric layer coatings and precise wavelength positioning and steepness. Other advantages of ALD coatings include defect free thus low optical loss, and super moisture/environmental resistance. Special ALD tools for handling large areas up to meter size, and multiple wafers up to hundreds/hour were demonstrated commercially. We present a cost effective DF development with ALD coating techniques for neutrino detector with a potential path for commercialization in collaboration with Raytium Photonics. The DFs with ALD coatings have been produced and is scheduled for the detector performance test in liquid argon at BNL.

Early Career

No

Primary author: LI, Yichen (Brookhaven National Laboratory)

Co-authors: DIWAN, Milind (BROOKHAVEN); Dr HU, Yimin (Raytium Photonics); Dr NIU, Feng (Raytium Photonics); Dr QIAN, Xin (Brookhaven National Laboratory); Dr ZHANG, Chao (Brookhaven National Laboratory); Dr LU, Steve (Brookhaven National Laboratory)

Presenter: LI, Yichen (Brookhaven National Laboratory)

Session Classification: Poster Session

Track Classification: RDC Parallel Sessions: RDC2: Photodetectors