2° Forum della Ricerca Sperimentale e Tecnologica

Parylene Aluminium Filters (ParALF)

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ParALF

Why on-surface optical filters for the High Energy Astrophysics Missions?

The new generation of High Energy Astrophysics (HEA) missions based on fast, precise and extremely sensitive Silicon based detectors demand a new generation of suitable optical light block filters. Currently, external filter designs and materials fulfil these requirements, but also add dead layers and degrade performance.

Aim

ParALF focuses on the integration of a Parylene - Aluminium filter on the surface of the silicon detectors followed by the testing, performance analysis and estimation of this filter with minimum possible thickness

Methodology

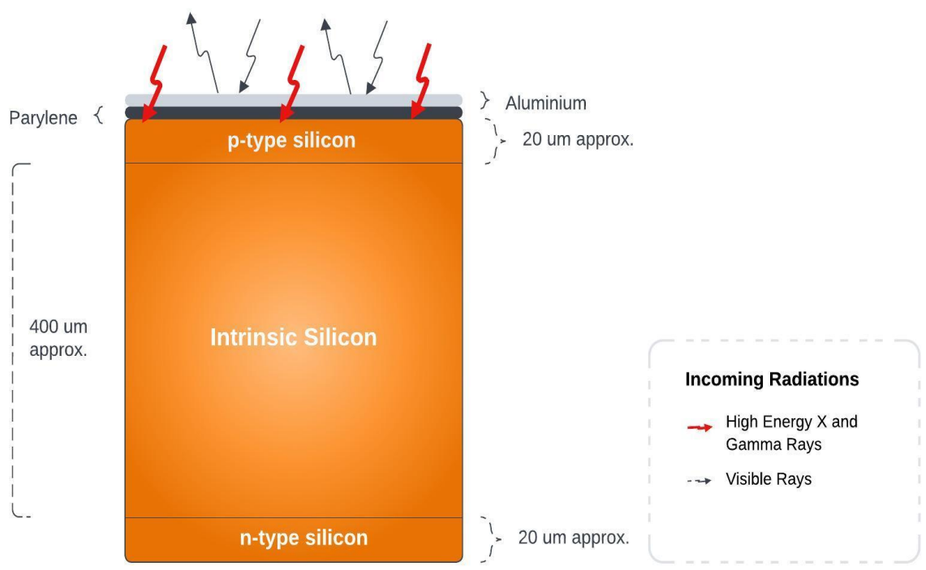
CHARACTERIZATION OF UNCOVERED SI - PIN DIODES

INITIAL CALCULATIONS X-RAY TRANSPARENCY & LIGHT OPACITY **MEASUREMENTS**

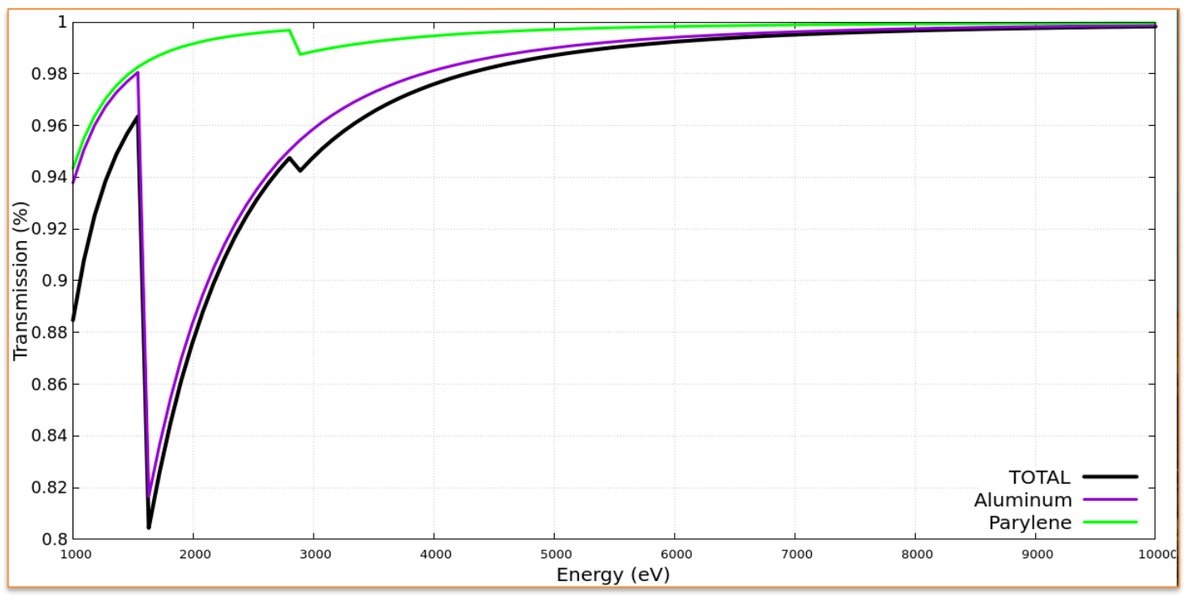
PASSIVATION LAYER: DEPOSITION OF PARYLENE LAYERS

REFLECTION LAYER: DEPOSITION OF ALUMINIUM LAYERS

THICKNESS OPTIMIZATION



Conceptual design of ParAlF on a typical Silicon detector surface

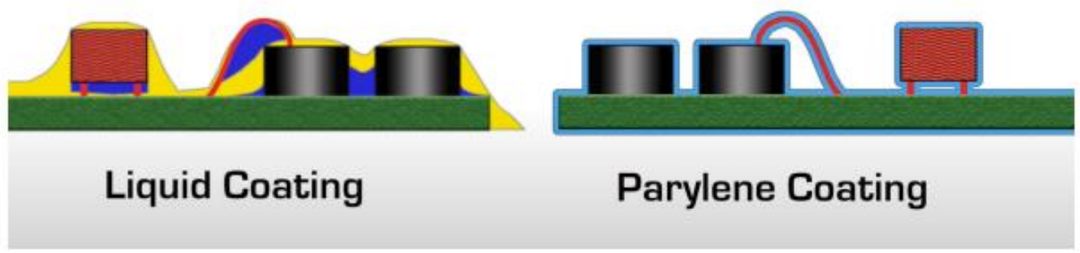


X-ray transmission variation for 0.2μm thick Al membranes (purple), Parylene (green) and total transmission (black)

Advantages

Parylene offers high temperature resistance, excellent dielectric strength, high conformity, µm thin film thickness manufacturability, space environment compatible

Aluminium being widely used in HEA missions offers adequate optical light block, high corrosion resistivity, high durability and is light weight



Conformal coating quality: Liquid coating (left) vs gaseous deposition of Parylene (Right)

Current Developments and Foreseen Steps

- Collaborative Steps for receiving materials and services from scientific institutes established, as follows;
- **IMEM CNR Torino** for the preparation of the Si-PiN Photodiodes samples with Parylene and Aluminium layers
- **Istituto per la Sintesi Organica e Fotoreattività (ISOF), Bologna** spectrophotometer testing for light opacity measurements of the Filter standalone
- Procurement of diodes and services in Progress
- Testing, performance analysis and result documentation in coming year
- Initiation of Services, Sample development and testing procedures ongoing

Possible Future Applications

Compact filters with more robust assemblies & direct On-chip deposition processes → Positive impact on future missions such as THESEUS, which, similarly to eXTP and HERMES, will utilize SDDs → Improved identification and understanding of GRB physics & GWs with electromagnetic counterparts → theseus M7 (Transient High Energy Sky and Early Universe Surveyor)

References: [1] Barbera, M. et al. 2022 http://arxiv.org/abs/2207.06781
[2] ECSS- ESA https://ecss.nl/standard/ecss-q-st-70-17c-durability-testing-of-coatings/
[3] VSI parylene https://vsiparylene.com/resources/the-essential-conformal-coating-comparison-guide/

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