Durable infrared optical coatings based on pulsed DC- sputtering of hydrogenated amorphous carbon (a-C:H)

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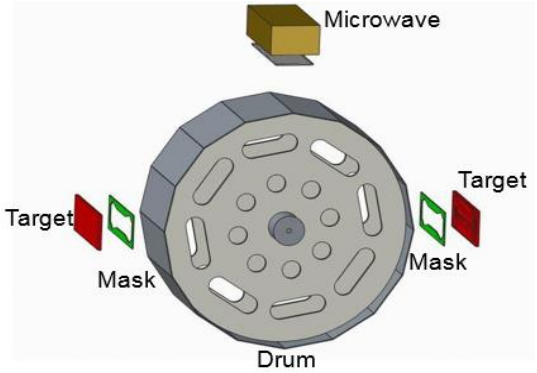
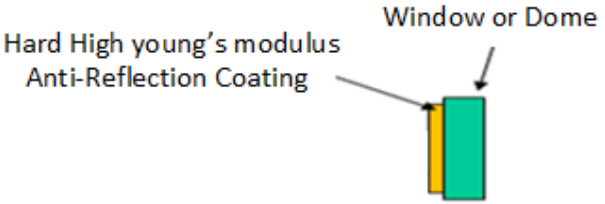
Abstract

Optical properties of low temperature pulsed DC sputter deposited (≤70°C) hydrogenated carbon are presented. Increasing hydrogen incorporation into the sputter deposited carbon significant decreases infrared optical absorption due to a decrease in deep absorptive states associated with dangling bonds. Results indicate suitability as a durable infrared optical coating for commonly used infrared substrates including temperature sensitive chalcogenide glass.



Schematic of patented High Throughput Microwave Assisted Pulsed DC Sputter System



Durable Hard, high Young's-modulus transparent anti-reflection coatings protecting brittle infrared window/ dome materials

Project Description

In this work low temperature (≤70°C) pulsed DC sputtering of amorphous hydrogenated carbon (a-C:H) is described. Increasing hydrogen incorporation into the sputter deposited a-C:H significantly decreases infrared broadband optical absorption. Increasing hydrogen incorporation reduces deposited film density with a consequent reduction in hardness, Young's modulus and compressive stress. As such hydrogen flow is optimized to achieve best compromise between increased infrared spectral transmittance, maximized refractive index, minimal extinction coefficient and high hardness & Young's modulus to achieve durable infrared anti-reflection coatings. This project demonstrates a novel pulsed DC drum-based a-C:H sputtering process compared to high temperature limited throughput plasma enhanced chemical vapour deposition of a-C:H.

Key Results, Conclusions, Comments, Impact

The sputtering process provides a number of key advantages – low temperature operation (hence compatible with deposition onto temperature sensitive substrates such as chalcogenide glass), high throughput based on rotating drum format and provision of multilayer anti-reflection optical coating processes which provide increased transmittance/ reduced reflectance over extended spectral ranges.

The patented high throughput process addresses a need for robust protective anti-reflection coatings for infrared (IR) optical materials used in applications requiring use in severe environments such as autonomous vehicle imaging systems.

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