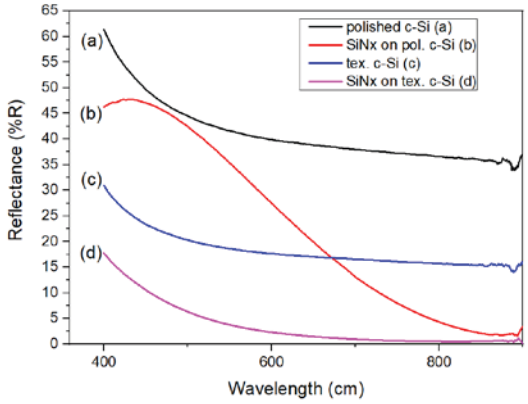
Deposition of Silicon Nitride Thin Films Using Hot-wire Chemical Vapour Deposition (HWCVD)



Problem Statement: Various industries such as energy, optoelectronics, MEMS, biomedical, ICs, etc., are becoming the principal technology development sectors in the Fourth Industrial Revolution (Industry 4.0). It is due to an immense focus on technology integration in developing materials, multidisciplinary systems, and hetero-devices to further enhance the scope of industrial applications. Silicon nitride constitutes one such material that is being explored with intense R&D for its optical and material properties, with applications in numerous industries. These applications include SiN films used as an insulator layer in Field Effect Transistors (FETs), a buffer/ capping layer in optoelectronics, and antireflective coating (ARC) in solar cells.

Uniqueness of the Solution: The team has employed the Hot-wire (or Cat.) CVD technique to deposit the a-SiN:H films on both polished and textured c-Si. The precursor gases used are silane (SiH_4), ammonia (NH_3), and nitrogen (N_2). This method allows for the deposition of silicon nitride films with tunable optical and material properties by varying deposition parameters: precursor gas ratio; deposition pressure; deposited a-SiN:H film; and the low substrate temperature (150-200°C). The HWCVD allows for the deposition of the films in a broader spectrum of base materials.

Current Status of Technology: Prototype of 80nm a-SiN:H ARCs with refractive index (RI) ~1.8 exhibiting an excellent reflectance of 1.7 % at 632 nm wavelength has been achieved on textured c-Si. To test the tunability of the deposited a-SiN:H, films with RI ranging from 1.8 to 3.5 and tensile stress running within ± 6 GPa have been fabricated.

Societal Impact: Apart from application in solar cells, silicon nitride ARCs are also used in corrective lenses to reduce glare for the wearer. It is also used on camera lenses for some components used for optical experiments with lasers. The prospects offered by HWCVD to deposit a-SiN:H films permit the fabrication of application-specific films that can be used in optoelectronic devices and FETs.

Patent(s): Nil

Relevant Industries: Energy, Renewables.

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