National Aeronautics and Space Administration

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TECHNOLOGY SOLUTION

Materials and Coatings

Ultra-Thin Large Area Polymer Film Fabrication Process

A process that enables the creation of large submicron scale-thickness free standing polymer films

Optical applications require clear windows for a number of applications including protection of instrument optics from dust and contamination and waveform band rejection. Very large area windows are required for next generation optical instruments. Fabrication of polymer films for optical devices require materials with high strength and exceptional thickness uniformity over large areas. For example, in x-ray or ultraviolet applications, very thin films are required for reduced absorption. There is also a need for incorporating topography to the films for a variety of optical applications. Current technologies require mechanical support structures that are fabricated by complicated lithographic processes. These methods may vary significantly across a wafer and may be detrimental in ultraviolet applications. Additionally, current processes are relatively expensive. The Ultra-Thin Large Area Polymer Film Fabrication Process is a new fabrication procedure that enables high uniformity structured large area thin films at a low cost.

BENEFITS

- Low cost
- Enables high uniformity
- Relatively simple technique

THE TECHNOLOGY

The Ultra-Thin Large Area Polymer Film Fabrication Process incorporates a class of polymer materials called cyclic olefin copolymers (COC). COC films have high transparency, minimal absorption bands in far-infrared, exceptional mechanical strength, low moisture absorption and compatibility with standard fabrication process chemicals. The process creates ultra-thin sheets of COC film over large areas that can be used for optical windows, filters and optical components from the X-ray to the far-infrared. Additionally, the process allows for highly uniform thin films with topography.

The fabrication process starts begins with a silicon wafer that is patterned with photolithography and etched using deep reactive ion etching. A cryogenic etching process may be used to reduce sidewall roughening. After the photoresist is removed, the silicon is cleaned and rendered hydrophobic through standard microfabrication processes. The COC film is spun on the etched silicon wafer, where the etched silicon wafer acts as a mold for the COC film. The COC film is baked on a hotplate. Since the COC film is a thermoplastic it will reflow during the curing process and fill the areas etched in the silicon wafer and planarize it's thickness. The COC film is able to be removed from the silicon wafer using a polymer tape frame and water submersion process. This fabrication process ultimately results in thin film that can have bumps or steps in areas where the silicon wafer has been etched for topography purposes.

APPLICATIONS

The technology has several potential applications:

- Optical device manufacturing
- X-ray spectroscopy
- Antireflective coatings

PUBLICATIONS

Patent No: 11168188; 11007685

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More Information

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