Chip-scale Broadband Mid-IR Chemical Sensors Using Silicon Waveguides
Technology #16158

Applications

The Mid-IR pedestal Si waveguide sensor is applicable to broadband Mid-IR scanning, real-time trace chemical detection, concentration monitoring, and identification of organic compounds. It also provides a unique flat form for next generation spectrometer-on-a-chip.

Problem Addressed

Silicon-on-Insulator (SOI) waveguide structures suffer significant optical loss because their silicon dioxide under-cladding layer becomes absorbing 3.7 μm. Specifically, conventional UV, visible and NIR sensors use weaker overtones of these fundamental chemical bands, which limits their practicality.

Technology

This invention is about a compact chip-scale air-clad silicon pedestal waveguide as a Mid-Infrared (Mid-IR) sensor capable of in situ monitoring of organic solvents. The sensor is a planar crystalline silicon waveguide, which is highly transparent between wavelengths of 1.3 μm and 6.5 μm, so that its operational spectral range covers most characteristic chemical absorption bands. To extend light transmission beyond the wavelength of 3.7 μm, a spectral region where a typical silicon dioxide under-clad is absorbing, we demonstrate a unique air-clad silicon pedestal waveguide. The sensing mechanism of the proposed Mid-IR waveguide sensor is based on evanescent wave absorption by functional groups of the surrounding chemical molecules, which selectively absorb specific wavelengths in the mid-IR, depending on the nature of their chemical bonds.

Advantages

- Chemically and mechanically robust due to air-clad silicon
- In situ identification of chemical compositions and concentrations of organic solvents
- Ultra-compact and portable spectrometer-on-a-chip

Categories For This Invention:

- Photonics
- Sensors (Photonics)
- Detectors

Intellectual Property:

Methods and apparatus for mid-infrared sensing