Licensing Opportunity

Pure Silicon Photonic Crystal Fiber Fabrication via Magnesiothermic Reduction for Operations in the Mid-IR Spectrum

Advantages
- Enables operation in the mid-IR (desirable for military targeting and biomedical diagnostic)
- Requires no traditional drawing of fragile silicon
- High optical damage threshold for fiber laser applications

Invention
The fabrication process for the production of microstructured silicon photonic crystal fiber by means of magnesiothermic reduction, converting an industrially mature technology into a completely novel device platform.

Background
Semiconductors have revolutionized the human condition by giving society the transistor and all its derivative computational technologies. The basic utility behind semiconductors revolves around the concept of an energy band gap. The band gap is a void in the allowable energy states of an electron, and enables us to control electron motion. In 1987 it was postulated that this same theory could be applied to the realm of optics to fabricate materials that feature a periodic dielectric constant (e.g. periodic air holes drilled through glass), and so the photonic crystal was born. Light that lies in the photonic band gap of a photonic crystal will simply not propagate into the periodicity. We may, therefore, guide light between regions of periodicity and fabricate new types of waveguide.

In photonic crystal devices, there exists an ability to confine light to a very small cross-section. This results in a new style of guiding which has lead researchers around the world to envision novel applications that exploit this highly confined and guided light. One such application, the photonic crystal fiber (PCF), is a threaded version of the photonic crystal and is applicable in communications, lasers, nonlinear conversion, and more.

Research into silica (SiO₂) PCF devices has been intensive and productive; proving itself a valuable technology. Unfortunately, the transition to pure silicon (Si) devices, featuring low loss in the mid-IR, high optical damage threshold, and wide availability, is not yet commercially feasible. However, UCF researchers have developed a novel process for directly converting silica PCF into pure silicon PCF by means of magnesiothermic reduction where a magnesium gas pulls the oxygen away from the silica device. This is the very first method which has shown the ability to fabricate pure silicon PCF.

Application
Photonic crystal fibers have become a very popular technology for use in fiber lasers, nonlinear devices, and guiding of exotic wavelengths. The prescribed fabrication process is the first method shown for fabrication of pure silicon PCF, making operation in the mid-IR region of the spectrum possible.

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