

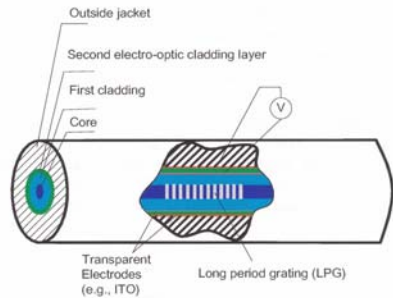
# Tunable Fiber Gratings and Their Applications to All Optic Funtionalities

Faculty members: Stuart Yin, Karl Reichard, Qiming Zhang

Students: Jon Lee, Corey Hahn, Sung Hyun Nam, Qing Chen, Fei Wu, Chun Zhan, Shaoying Kang, Yi Yang

## Ultra-fast All-fiber Tunable Filter

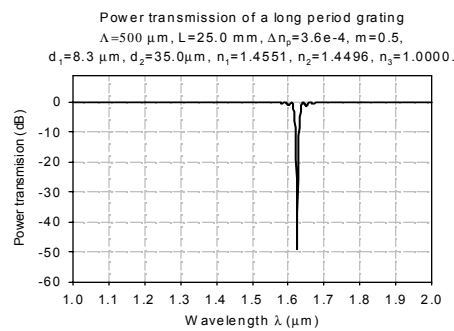
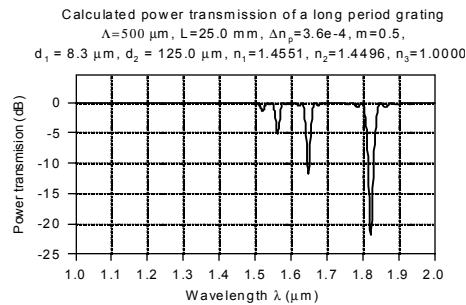
➤ To produce a thermally stable tunable filter that exceeds the performance capabilities of all commercially available tunable devices



Tunable Filter Design Utilizing Long Period Grating, Ultra-Thin Cladding, and Electro-Optic Second Cladding Layer

## Long Period Grating with Ultra-Thin Cladding

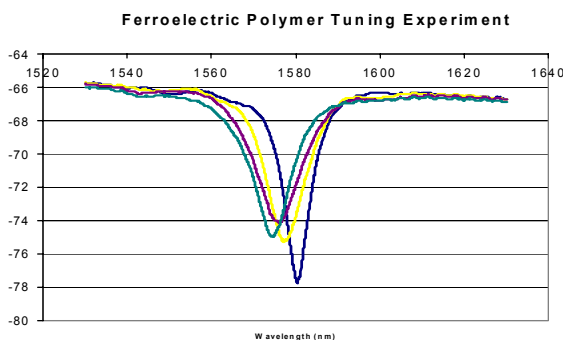
➤ Ultra-thin cladding changes the spectral response of the long period grating to a single resonant peak  
➤ Standard LPG generates many resonant peaks in the spectral response by selectively coupling wavelengths from the core to the cladding



The resonant wavelength is filtered from the signal and is tuned by controlling the refractive index of the surrounding medium

## Electro-Optic Tuning

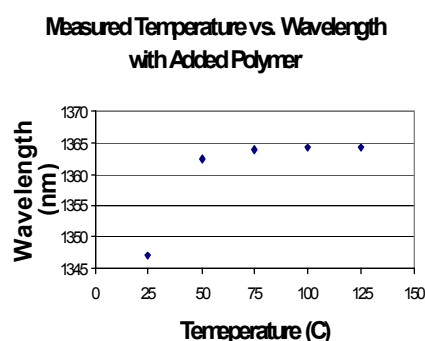
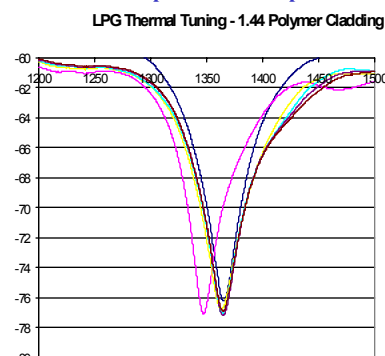
➤ A second cladding made of electro-optic polymer is used to control the refractive index surrounding the ultra-thin cladding  
➤ Filtered wavelength is tuned by controlling the refractive index of the electro-optic polymer cladding with an applied electric field  
➤ Preliminary tuning experiments used ferroelectric polymer or liquid crystal based polymer.



-6 nm shift for applied electric field of 100 V/μm

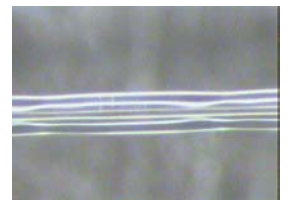
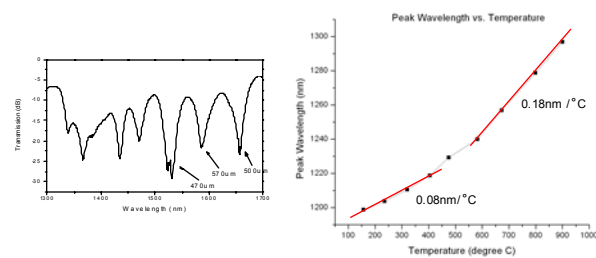
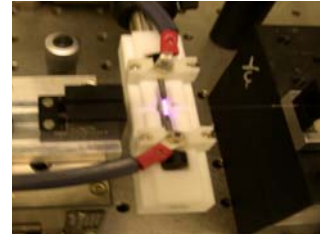
## Thermal Effects

With the proper polymer cladding, the filtered wavelength is a function of the electric-field and is independent of temperature.



## High Temperature Harsh Environment Sensing

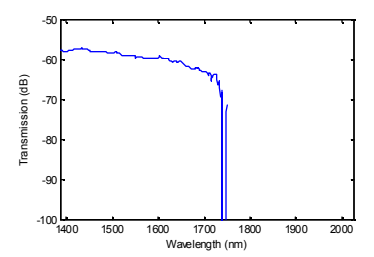
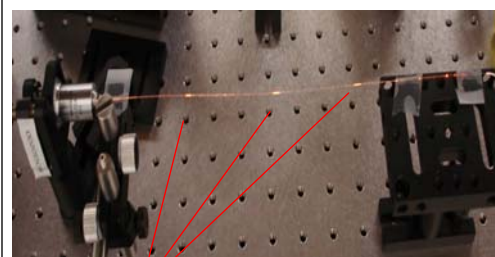
- High temperature distributed sensing can play a key role in fuel industry.
- Long period gratings written by electric arc method can survive up to  $\sim 800^\circ\text{C}$



Long Period Gratings on silica fibers

## Bragg Gratings on Sapphire Fibers

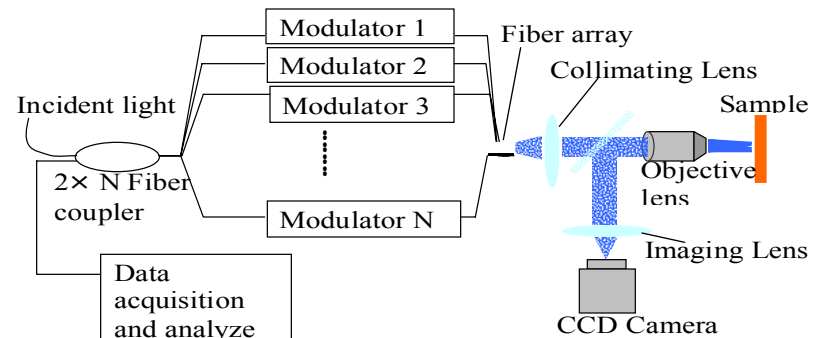
- Super corrosion resistance
  - High melting temperature ( $\sim 2050^\circ\text{C}$ )
  - Excellent Material for High Temperature Sensing
- Multiplexed sapphire FBG will provide an excellent solution for high temperature sensing in harsh environments



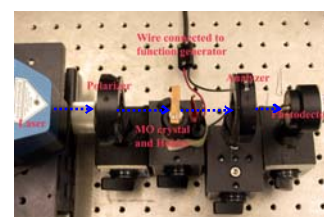
Bragg gratings written by femtosecond laser

## Other Optics Funtionalities

### Multiplexed Confocal Microscopy



### High Speed Magneto-optic Switch



Magneto-Optic Switch Setup

