



## Italy Chapter of the IEEE Sensors Council Lecturer

### Development of Optical Fiber Sensors for Various Applications

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**Università Campus Bio-Medico di Roma  
Via Alvaro del Portillo,21- 00128, Roma  
Room T14**

#### **Abstract:**

Thanks to light weight/small size, high sensitivity/large band width, long range operation, and harsh environment capability, optical fiber has gained immense attention in sensor field. The optical fiber sensor can be either intrinsic or extrinsic type considering the passage of light and optical modulation mechanism can be by intensity, phase, wavelength and polarization. It has been used to measure various chemical and physical properties, such as temperature, pH, pressure, humidity, flow rate, gas concentration, liquid level, radiation, displacement, vibration, and chemical species

My group developed optical fiber sensors for 5 applications; 1) Aerosol 2) VOCs 3) Biomolecule, 4) Radiation and 5) Force.

- 1) Aerosol: TEOS and thymol blue (TB) were used for the preparation of silica cladding on optical fiber core. The coated optical fiber is found to be sensitive to composition of aerosol based on evanescent wave absorption. Moreover, conductive polymer, polypyrrole (PPy) thin film coated optical fiber was used for NaCl, PSL, and BC aerosol sensing.
- 2) VOCs: PPy thin film coated optical fiber was used for VOCs sensor. Its detection limit is ~1 ppm level. Similarly, DNA and metal ion-modified DNA (M-DNA) coated on quartz plate was used for VOCs sensor based on surface change. M-DNA is more sensitive than DNA for sensing. Additionally, Graphene oxide (GO) and reduced-GO (rGO) were coated on tip of optical fiber and used for detecting 8 kinds of VOCs.
- 3) Biomolecule: Reusable PDMS waveguide-graphene FET hybrid sensor was developed for biomolecular interaction monitoring. Its sensing mechanism is based on changing evanescent field. Moreover, graphene was used as a novel surface plasmon supporting material for highly sensitive biosensors. Graphene was also employed as composite material with MoS<sub>2</sub> for synergetic effect. The MoS<sub>2</sub>-graphene composite was used for electrochemical sensor with increasing sensitivity of PTH hormone.
- 4) Radiation: Alpha radiation can induce tracks on the surface of CR 39/ LR 115 film. These tracks can be detected by the change of reflection light intensity. Blue light (450 nm) was used

for real-time measurement of radiation damage of the surface and compared with AFM measurement. Similarly, DNA this film was utilized to observe the damage of its surface by  $^{241}\text{Am}$  (Alpha radiation source) for radiation sensor.

- 5) Force: FBG (Fiber Bragg Grating) was used for force sensor with flexure structure and its wavelength change was used for changing force and it can apply for catheterization.

In this lecture, I will review previous results from my group and discuss about the future direction.

### Short CV: Biography:

Dr. Taesung Kim received his Bachelor's in Mechanical Engineering from Seoul National University, Korea in 1994. He received his Master's, and Ph. D. in Mechanical Engineering from University of Minnesota, USA in 1998 and 2002, respectively. He joined Seagate Technology in 2002 and worked as Sr./Staff Engineer in Recording Head R&D.

Since 2005 Dr. Kim has been a professor in the School of Mechanical Engineering and SKKU Advanced Institute of Nanotechnology (SAINT), Sungkyunkwan University in Suwon, Korea. In 2014, he was appointed as SKKU Young Fellow and started working for SKKU Research & Business Foundation as a Vice President. His research interests include 2-D material synthesis, optical fiber sensors, semiconductor/display manufacturing process (CMP, cleaning and contamination control), and atmospheric/indoor aerosol control.



### Research Summary

- 153 publications in SCI or SCI(E)
- 51 Korean, 5 USA, 3 Japanese registered Patents
- Successfully completed 45 Government & 23 Industrial Projects

### Society participation:

- President: Korea CMPUGM
- Vice president: Korean Society of Mechanical Engineering, KAPAR, SAREK
- Committee member: Korea Air Cleaning Association, Korea SCUGM
- Associate Editor: IJACR, JMST

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