DEPARTMENT OF
MECHANICAL ENGINEERING

ME Spring Seminar 10

Catching Light, Guiding Flow: Toward Photocatalytic Nanofibres Under Low Illumination

Prof. Ki Joon Heo

School of Mechanical Engineering
Chonnam National University

Airborne microorganisms pose persistent risks to indoor air quality and public health, particularly in enclosed environments where bioaerosols accumulate and propagate. Fibrous filtration remains the most widely adopted countermeasure, yet conventional filters cannot prevent microbial growth on captured particles and often become secondary sources of contamination. Antimicrobial coatings have been introduced to suppress such proliferation, but their effectiveness is rapidly diminished by dust loading and surface fouling under realistic operating conditions. Photocatalytic filters have recently emerged as a promising alternative, offering continuous, self-regenerating disinfection through reactive oxygen species (ROS) generated under light irradiation.

The present study investigates the practical deployment of photocatalytic filters under indoor gas-phase conditions, with particular emphasis on operation under low-illuminance visible light representative of real indoor environments. This work addresses a critical gap between laboratory demonstrations and real-world applicability. Photocatalytic performance is first examined on microfibre-based substrates to establish the disinfection behaviour of ROS-driven systems against airborne microorganisms. To extend this approach towards higher surface area and enhanced reactivity, the fabrication of nanofibre structures is explored as a next-generation platform. The nanofibre architectures are designed and fabricated via air-assisted electrospinning. The scalability of nanofibre production is explored to assess the feasibility of translating this technology toward commercial deployment.

Since flow through nanofibre assemblies departs from the continuum regime, owing to the comparable scales of fibre diameter and the gas mean free path, computational fluid dynamics (CFD) analyses incorporating slip-flow boundary conditions are conducted to capture the transport behaviour accurately. These findings collectively provide a design basis for translating low-illuminance visible-light photocatalysis from microfibre to nanofibre filters, advancing towards practical indoor bioaerosol control.

Bldg.110 #N105

16:00 - 17:15

Wednesday, **May 27**

Host:
Prof. Kang Soo Lee (kangsoolee@unist.ac.kr)