Center for Molecular Spectroscopy and Dynamics, IBS-Korea University

IBS Center for Molecular Spectroscopy and Dynamics

COLLOQUIUM

- **SPEAKER**
  Prof. Hong-Gyu Park (Department of Physics, Korea University)

- **TITLE**
  Novel nanophotonic devices: graphene-based nanolasers & photon-triggered nanowire transistors

- **ABSTRACT**
  In this talk, I will present graphene-based nanolasers and photon-triggered nanowire transistors. First, I'll talk about the demonstration of coupled photonic-crystal nanolasers with asymmetric optical gains [1]. We observed the phase transition of lasing modes at exceptional points through tuning of the area of graphene cover on one photonic-crystal cavity and systematic scanning photoluminescence measurements. As the gain contrast between the two identical photonic-crystal cavities exceeds the intercavity coupling, the phase transition occurs from the bonding/anti-bonding lasing modes to the single-amplifying lasing mode, which is confirmed by the experimental measurement of the mode images and the theoretical modeling of coupled cavities with asymmetric gains. In addition, we demonstrated active tuning of exceptional points by controlling the optical loss of graphene through electrical gating. Furthermore, I'll present the demonstration of on/off switching of single- and double-cavity photonic crystal lasers by electrical gating of a monolayer graphene sheet on top of photonic crystal cavities [2]. The optical loss of graphene was controlled by varying the gate voltage, with the ion gel atop the graphene sheet.

  Second, I'll show photon-triggered nanowire transistors, photon-triggered nanowire logic gates and a single nanowire photodetection system [3]. Nanowires are synthesized with long crystalline Si segments connected by short porous Si segments. Exposing the porous Si segment to light triggers a current in the nanowire with a high on/off ratio of >8 × 106. A device that contains two porous Si segments along the nanowire can be triggered using two independent optical input signals. Using localized pump lasers, we demonstrated photon-triggered logic gates including AND, OR and NAND gates. Furthermore, we take advantage of the high photosensitivity and fabricate a submicrometer-resolution photodetection system. We believe that photon-triggered transistors offer a new venue towards multifunctional device applications such as programmable logic elements and ultrasensitive photodetectors.

[1] K.-H. Kim et al., "Direct observation of exceptional points in coupled photonic-crystal lasers with asymmetric optical gains," Nature Communications 7, 13893 (2016).

[2] M.-S. Hwang et al., “Switching of photonic crystal lasers by graphene,” Nano Letters 17, 1892-1898 (2017).

[3] J. Kim et al., “Photon-triggered nanowire transistors,” Nature Nanotechnology 12, 963-968 (2017).

- **DATE AND VENUE**
  March 21, 2018 (Wednesday, 5:00 - 6:00 pm)
  Seminar Room 116, KU R&D Center

- **LANGUAGE**
  Korean

- **INVITED BY**
  Director Minhaeng Cho