PNU-SKKU Quantum Matter Seminar Series

Optoelectronics with oxides and oxide heterostructures

Speaker Prof. Alexander A. Demkov (The University of Texas at Austin, USA)

Date **December 9(Wed.), 2020 | 9:00AM – 10:30AM**

ZOOM Webinar https://us02web.zoom.us/j/82444236212?pwd=Q1VzaDgwTFRqcHkrRDUrSmFzRUZ5QT09

Abstract Si photonics is a hybrid technology combining semiconductor logic with fast broadband optical communications and optical information technologies. With the increasing bandwidth requirement in computing and signal processing, the inherent limitations in metallic interconnects are seriously threatening the future of traditional IC industry. Silicon photonics can provide a low-cost approach to overcome the bottleneck of the high data rate transmission by replacing the original electronic integrated circuits with photonic integrated circuits. The range of emergent applications of this technology includes intra-chip data transmission, neuromorphic logic optical chips and photonic integrated circuits for quantum computing. The development has proceeded along several avenues including mounting optical devices based on III-V semiconductors and/or $LiNbO_3$ (LNO) on Si chips, incorporation of active optical impurities into Si, and utilization of stimulated Raman scattering in Si. All these approaches have had limited success. Recently, another path to Si photonics through epitaxial integration of transition metal oxide films was demonstrated when an effective electro-optic (Pockels) coefficient of $BaTiO_3$ (BTO) films epitaxially grown on Si *via* an $SrTiO_3$ buffer was reported to be an order of magnitude larger than that in commercially-available LNO modulators. More generally, epitaxial growth of $SrTiO_3$ on Si(001) enables monolithic integration of many functional perovskite oxides on Si, including ferroelectric BTO, ferromagnetic $LaCoO_3$, photocatalytic TiO_2 and CoO, and many others.

In this talk, I will focus on two materials systems integrated on Si (001) and well-suited for implementation in the next-generation optical technologies: $SrTiO_3/LaAlO_3$ quantum wells and Pockels-active BTO thin film heterostructures. Both materials systems are promising for use in a wide variety of optical and electro-optical devices central to integrated photonic technologies, including quantum cascade lasers, photodetectors, electro-optic modulators and switches. The resulting devices achieve refractive index tuning with power consumption many orders of magnitude less than previously reported. Taken together, these two approached will hopefully open the door for the development of new kinds of optical and electro-optical devices for use in integrated photonics technologies.

대칭성제어 양자물질연구단 / 유전체물성연구소 / 부산대학교물리학과 / 성균관대학교물리학과

Center for Innovative Physicist Education and Research
혁신융합형물리인재교육연구단
부산대학교

SUNG KYUN KWAN UNIVERSITY