

Band structure of oxide semiconductors for optical neuromorphic devices to realize highly efficient and accurate machine vision

Seong Jun Kang

Department of Materials Science and Engineering, Kyung Hee University, Republic of Korea

This talk will focus to introduce a new type of optoelectronics based on oxide semiconductors for advancing machine vision technology. In-sensor computing systems based on optical neuromorphic devices have attracted increasing attention to improve the efficiency and accuracy of machine vision systems. However, most materials used in optical neuromorphic devices exhibit spike-timing-dependent plasticity (STDP) behavior in response to input light signals, leading to complex in-sensor computing and reduced machine vision accuracy. To address this issue, we introduce a novel band structure of oxide semiconductor designed to enhance spike-number-dependent plasticity (SNDP) in response to input light signals while eliminating STDP behavior. As a result, in-sensor computing with the SNDP-enhanced device reduces multi-layer perceptron (MLP) training time by 87.7 % while achieving high classification accuracy. This study demonstrates that in-sensor computing systems with SNDP characteristics in optical neuromorphic devices have significant potential to accelerate machine learning for highly efficient machine vision systems.

References

1. Min Ho Park, Yeojin Kim, Min Jung Choi, Yu Bin Kim, Jung Min Yun, Jun Hyung Jeong, Seunghwan Kim, Soohyung Park, Seong Jun Kang, *ACS Nano*, **19**, 13107 (2025).