KEYNOTE FORUM

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Atomic semiconductor via flat phonon bands in HfO_2

Flat energy bands in the momentum space of electrons were known to generate spatially localized states and produce unconventional phenomena such as graphene superconductivity. However, flat bands in a phonon had not been discovered yet. We were the first to discover that they exist in a ferroelectric HfO_2 and produce localized polar displacement of individual atomic layers. Strikingly, this atomic layer is freely displaced by external voltage for the densest information storage. Our theory of atom control directly in solid is applicable to the Si-compatible HfO_2, so can be materialized in most electronic devices reaching up to ~100 TB memories.

Biography

Jun Hee Lee is a computational materials scientist. He obtained his PhD in Physics from Seoul National University in 2008. Then he moved to USA as a postdoc at Physics Dept. of Rutgers University (2008~2011), Chemistry Dept. of Princeton University (2011~2013), and Materials division of Oak Ridge National Lab. (2013~2015). Now he joined UNIST in Korea in 2015 as an assistant professor and is an associate professor. Combining his interdisciplinary background, he has been actively working in various fields such as ferroelectrics, multiferroics, polymers and energy materials including photocatalysts, fuel cells, and batteries. He published 70 SCI papers including a recent theory paper in Science "Scale-free ferroelectricity by flat phonon bands in HfO_2", Science 369, 1343 (2022). Nowadays he is extending his theoretical research across industries to realize ultimate-density semiconductors reaching up to ~100 TB.

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