Prof. Vincent Tung

Office: Engineering Bldg 3, Level 5, Room 5A06

E-mail: vincent.tung (at)g.ecc.u-tokyo.ac.jp

Ph.D. in MSE, UCLA

Postdoc in MSE, Northwestern University

Website：http://www.vctunglab.org/

Introduce：

We focus on pushing the frontier of epitaxy science and engineering needed to translate the extraordinary properties of the emerging two-dimensional (2D) layered materials, from chalcogenides, carbides, nitrides, borophene, perovskite and oxides to graphene, into real-world applications. To this end, we stand out by offering: (1) innovative concepts of epitaxy mechanisms (Nature Materials 2020 & 2022), and (2) new understanding of 2D mechanics (Nature Electronics 2021 and Nature Nanotechnology 2022), enabling us to access unprecedented structure-property-function relationships – crucial to developing novel applications of 2D materials and their assembly into mix-dimensional van der Waals (VDW) heterostructure for electrochemical capacitors, catalysis, reactors and separation, drug delivery, e-skin sensing and highly complexed composites.

Reserch：

1. Leading the Edge: Wafer-scale Epitaxy of Single-crystal, non-Silicon Monolayer Semiconducting Materials with Ultrahigh Mobility

The holy grail of next-generation electronics is to identify viable alternatives for non-Silicon electronics with synthetic scalability, industry-compatible processability, crystallinity, and most importantly, ultra-high mobility. Chemical vapor deposition (CVD) provides an enabling platform to stitch dissimilar atoms into functional molecules where the periodic and repeated arrangement of lattices is perfect and extends throughout the entirety of the specimen without interruption. The result is the wafer-scale uniformity and unparalleled electronic properties on par with the mechanically exfoliated benchmarks. Current projects straddle across (a) lattice orientations; (b) heterogeneous junctions; (c) dopants; (d) metal contacts; and (e) device integration, respectively. Notable applications include but are not limited to the internet of things (IoT), flexible electronics, and next-generation semiconductors.

Collaboration:

Prof. Jeehwan Kim, Prof. Tomas Palacios, and Prof. Jing Kong at MIT ;
Prof. Lance Li at HKU;
Prof. Deep Jariwalla at UPenn;
Prof. Wen-Hao Chang at NCTU, Taiwan;
Prof. Thomas Anthopoulos, Prof. Yu Han, and Prof. Luigi Cavallo at KAUST.

2. Macro-scale Printing of Transition Metal Dichalcogenides Metamaterials with Control of Hierarchy at Nanoscale

The deployment of dimensional transitions is ubiquitous in nature, ranging from the Venus flytrap, the beating of a heart sounds shaped by the vocal folds, and zooming of the focal length by the human eye. External stimuli in the form of chemical or mechanical cues arising from the environment result in the deformation of materials. Such a dimensional transition leads to new functionalities, which cannot be found in their original formats. We explore nature-inspiring synthetic strategies to systematically study the self-assembling behaviors, underlying mechanisms, and the associated material properties, ultimately enabling the microscopic integration and macroscopic deposition of these 2D transition metal dichalcogenides into 3D hierarchical metamaterials. Potential applications include structural reinforcement, energy storage, electrochemical catalysis, responsive smart materials, and sensors.

Collaboration:

Prof. Jing Kong at MIT;
Prof. Richard Kaner at UCLA;
Prof. Han-Yi Chen at National Tsing Hua University;
Prof. Andy Huang, Prof. Zhiping Lai, and Prof. Yu Han at KAUST