



Materials Science and  
Engineering

# MSE COLLOQUIUM SPEAKER

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Zoom Link: <https://ucr.zoom.us/j/95770338533?pwd=anQ4YjNTNzNNQ3M3U2EvOFgrT2E5dz09>

The synthesis and engineering of two-dimensional Janus quantum layers

Named after the two faced Roman God Janus, 2D Janus layers contain two different atomic types on its top and bottom faces. Previous theoretical studies have shown that broken mirror symmetry together with large charge transfer across the top and bottom face opens up completely new quantum properties including Rashba effect, colossal Janus field, dipolar excitons, and Skyrmion formation. Despite the theoretical advances in the field, experimental results are still limited due to limitations in high quality 2D Janus layer synthesis. In this talk, I will introduce recent discoveries made at Arizona State University towards different types of Janus layers. The growth process relies on Plasma enhanced low pressure chemical vapor deposition (PE-LPCVD). With this all room temperature technique, our team can synthesize different Janus layers as well as their vertical / lateral heterojunctions, and Janus nanoscrolls. Further studies from our team will introduce on-demand fabrication of 2D Janus layers with unique in-situ growth capabilities that allows us to collect spectroscopy data during the course of Janus material growth. Results are presented along with microscopy, spectroscopy, high - pressure studies, and electronic transport datasets for complete understanding of these systems<sup>1-5</sup>.



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Sefaattin Tongay is the chair of undergraduate materials science and engineering program at the School for Engineering of Matter, Transport and Energy (SEMTE) at Arizona State University. Prior to his appointment at ASU, he has completed his postdoctoral studies at the University of California, Berkeley at the Materials Science and Engineering Department with Professor Junqiao Wu. He received his doctorate at the University of Florida in 2010 working with Distinguished Professor Arthur F. Hebard.

His work focuses on the discovery, synthesis, manufacturing, and applications of quantum materials and technologies. His team uses state-of-the-art manufacturing and characterization techniques to enable next-generation applications such as quantum information, energy conversion (catalysis, photovoltaics), chemical engineering (desalination, purification, and gas separation). He has published more than 220 SCI-indexed research articles in prestigious journals such as Science, Nature, and others. He currently has an h-index of 62 and holds a number of key patents on 2D materials. His work received wide media coverage from Nature publications, Scientific American, MIT News, Science Daily, Phys.org and various other media sources. Prof. Tongay also serves as an editorial member of AIP Applied Physics Review (impact factor 19) and more recently Nature Publishing Journal Nature 2D Materials and Applications.