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 change 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 systems1-5.

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