Department of Materials Science and Engineering
Ph.D. Candidacy Exam
August 15th, 2025 – 2 PM
Hill Conference Room,
https://drexel.zoom.us/j/81720407717?pwd=of6ps12yMyVB0Eq2KilTAzu784y2YV.1

CVD-Based Strategies for Synthesis of 2D Metal Carbides and Nitrides

Name: Deniz Cakir
Advisor: Prof. Yury Gogotsi
Materials Science and Engineering, Drexel University

Abstract

Transition metal carbides and nitrides (TMCs and TMNs) are versatile materials known for their excellent electrical, thermal, and chemical stability, making them suitable for various technological uses. The development of two-dimensional (2D) carbides and nitrides, especially MXenes, has broadened the field by providing new structures with adjustable properties. Traditionally, 2D carbides and nitrides are created from 3D precursors through top-down etching techniques. However, chemical vapor deposition (CVD) has gained attention as an effective bottom-up method for producing both 3D and 2D transition metal carbides and nitrides, allowing better control over their composition, crystallinity, and shape. This presentation offers a comparative overview of 3D and 2D TMCs and TMNs, focusing on their structural features and functional behavior. It will include a detailed discussion of CVD synthesis methods, highlighting how key processing parameters, such as temperature, gas composition, pressure, reaction time, and precursor chemistry, affect the formation pathways and structural development of these materials. Particular attention will be given to current efforts and challenges in the direct synthesis of MXenes via CVD, addressing recent advances and limitations in achieving phase-pure, layered 2D structures without etching. By reviewing and analyzing recent literature, this work aims to identify knowledge gaps in the synthesis of TMCs and TMNs for CVD and propose strategies to guide future experimental research in developing novel 2D materials.