Materials Science and Engineering Department

Winter Seminar Series

Growth of Large-Area 2D Mo_2C via CVD

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11AM-12PM | Hill Seminar Room (LeBow 240)

In this seminar, I will briefly reflect on my past research as a PhD student at Drexel University and share my academic journey as a faculty member afterward. Following an overview of my recent research areas—such as carbon nanostructures on SiC as field emitters and graphene-copper composites for thermal management—I will delve into the growth of large-area, high-quality 2D molybdenum carbide (Mo_2C) via chemical vapor deposition (CVD) for advanced electronic applications.

Two-dimensional (2D) ultrathin carbides, such as molybdenum carbide (Mo_2C), exhibit exceptional properties that position them as promising candidates for advanced technological applications, including energy storage and quantum materials. Despite their potential, achieving large-area, high-quality crystals with uniform morphology remains a significant challenge. Conventional chemical vapor deposition (CVD) methods, while effective in synthesizing Mo_2C, often encounter limitations such as random crystal sizes, and the undesired co-deposition of graphene.

This seminar will explore the process mechanisms underlying the growth of 2D Mo_2C through CVD, emphasizing critical parameters that influence growth outcomes. Particular attention will be given to our systematic investigation of graphene's role in the growth of 2D Mo_2C crystals. By comparing the results with a novel approach we developed, we have identified the significant impact of graphene on Mo_2C formation.

Our innovative technique involves annealing a layered Mo/Cu/graphene framework, where pre-existing graphene is transformed into Mo_2C without requiring an additional carbon source. This method allows precise control over the morphology of Mo_2C crystals, mitigating the challenges associated with the formation of graphene/Mo_2C heterostructures. Characterization through Raman spectroscopy and scanning electron microscopy (SEM) reveals that graphene functions as both a carbon source and a structural modifier, yielding larger and thinner Mo_2C crystals compared to alternative techniques.

The seminar will conclude with an outline of ongoing and future work at Drexel University, focusing on a comparative study of CVD-grown Mo_2C and MXene Mo_2C to evaluate their respective properties and applications. This effort aims to provide deeper insights into the controlled synthesis of Mo_2C and other 2D materials and their integration into emerging technologies.

Dr. Göknur Cambaz Büke is a full professor in Materials Science and Nanotechnology Engineering, renowned for her expertise in the synthesis, characterization, and application of nanostructures, with a particular focus on two-dimensional (2D) molybdenum carbide (Mo_2C), graphene, and carbon nanotubes (CNTs). Her research emphasizes chemical vapor deposition (CVD) techniques and other methods for the controlled growth of nanostructures, addressing both fundamental challenges and practical applications. Currently, she is spending her sabbatical at the A.J. Drexel Nanotechnology Institute.

After graduating from Middle East Technical University (METU) in Turkey, Dr. Buke completed her Ph.D. in Materials Science and Engineering under the supervision of Prof. Dr. Yury Gogotsi at Drexel University in 2007. During her doctoral studies, she received several prestigious awards, including the Roland B. Snow Award, the Ludo Frevel Crystallography Scholarship, the Teaching Excellence Award, and the Graduate Student Research Award.

Upon returning to Turkey, Dr. Buke joined TOBB University of Economics and Technology (TOBB ETU) as a faculty member, where she founded the TOBB ETU Nanomaterials Group. Under her leadership, the group has secured substantial funding from TUBİTAK and the U.S. Air Force Office of Scientific Research (AFOSR), contributing significantly to the field through publications, patents, and the mentorship of numerous students.

Dr. Buke has also extended her expertise to national and industry-oriented initiatives, serving as an Advisory Board Member of The Scientific and Technological Research Council of Turkey (TUBİTAK), a committee member in NATO's AVT Program for Graphene Technologies and Applications for Defence, and as a Co-Founder and Board Member of TEKMER GARAJ X Company.

In addition to her research, Dr. Buke has taken on several administrative roles at TOBB ETU, including Vice Chair of the Department and Vice Director of the Graduate School of Engineering and Science. Since 2020, she has been serving as Vice Provost for Research and Technology Transfer.

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