סמינר מחלקתי – הנדסת חומרים

הנכם מוזמנים בזאת לסמינר מחלקתי
אשר יתקיים ביום ה', 14 בנובמבר 2024 , יג' בחשון תשפ"ה,
בשעה 11:00, בניין 51 באולם 15

Chemical Solution Deposition on Micro-Patterned Substrates

Taissia Rudnikov-Keinan

Supervisor: Prof. Yuval Golan[a,b]

(a) Department of Materials Engineering, Ben-Gurion University of the Negev, Beer-Sheva 8410501, Israel

(b) Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer-Sheva 8410501, Israel

As a result of miniaturization in science and engineering systems, the impact of confined spaces on crystallization has become increasingly important, particularly with the ongoing advancements of nanotechnology, lab-on-chip devices and microfluidic systems. Confinement effects are known to influence diffusion, crystal phase formation, and structural defect density, making the study of semiconductor growth on micro-patterned substrates, such as trenches with laterally confined growth areas or within 2D confined wells, of significant interest.

In the initial stage of our research, we investigated the influence of patterning processes, specifically chemical etching with different acids, on substrate characteristics, particularly micro-faceting, and their impact on the growth and properties of PbS thin films. We provided the first reported evidence of PbS thin films deposited on GaAs(311) microfacets with {113}/⟨110⟩ twinning relations. Furthermore, we demonstrated that shallow trenches can be used to control film morphology, microstructure, and crystalline quality. This was evidenced by the reduction of threading dislocation density (TDD), which decreases with increasing film thickness. The effect of trench width on TDD and film thickness, considering both cluster and ion-by-ion chemical deposition mechanisms, was explored in detail.

In the final stage of our research, we investigated the growth mechanism of Cu_2O thin films on GaAs substrates. We identified the crucial role of Cu^{2+} cation diffusion into the GaAs substrate and redox reactions that lead to the reduction of Cu^{2+} to Cu^{+}. Additionally, we successfully demonstrated the growth of single-crystal Cu_2O (100) thin films within 2D confined wells. Our findings underscore the critical role of 2D confinement parameters, such as dimensions and in-plane rotation, in stabilizing epitaxial single-crystal Cu_2O (100) films.