Contribution ID: **22**

Type: **Keynote**

MOVPE of III-V Materials: The (Neglected) Role of Surface Dynamics and its Potentials for Next Generation Devices and Integration

Wednesday, 14 September 2022 14:30 (30 minutes)

Over the last ˜50 years, semiconductor epitaxy has shaped our high-tech society. While several epitaxial growth technologies have been successfully used for decades, few have been utilised industrially and are implemented for large-scale, high-volume applications. Metalorganic Vapor Phase Epitaxy (MOVPE) is one of these well-established technologies, underpinning the majority of III-V semiconductor device fabrication (especially in photonics), and underlying key developments not only for III-Vs, but also III-Ns for lighting and power solutions.

Despite the broad technological use of MOVPE, there still persist a large number of fundamental unresolved issues. These are tightly tied to a lack of understanding of the complexity of the epitaxial process and dynamics, and, as a result, are effectively limiting a broad range of further device developments.

Here we will discuss ˜ 20 years of research and related results which importantly contributed to establish the current understanding, starting from highlighting the relevance of metalorganic precursors for growth on planar and patterned substrates [1, 2].

We will highlight the surprising "zoology" of the reported surface organization and underline the need for proper theoretical modelling, including describing unexpected surface organization paths, such as Volmer-Weber dot formation at the lattice matched InP/AlInAs interface [3].

We will also present novel results on surfactant physics, including presenting clear evidence that one of the main device design limiting factors in today's MOVPE processes (i.e. Zn diffusion complicating P-I-N device stacking) actually is not often linked to "*crystallographic*" diffusion but indeed induced by surfactant effects [4].

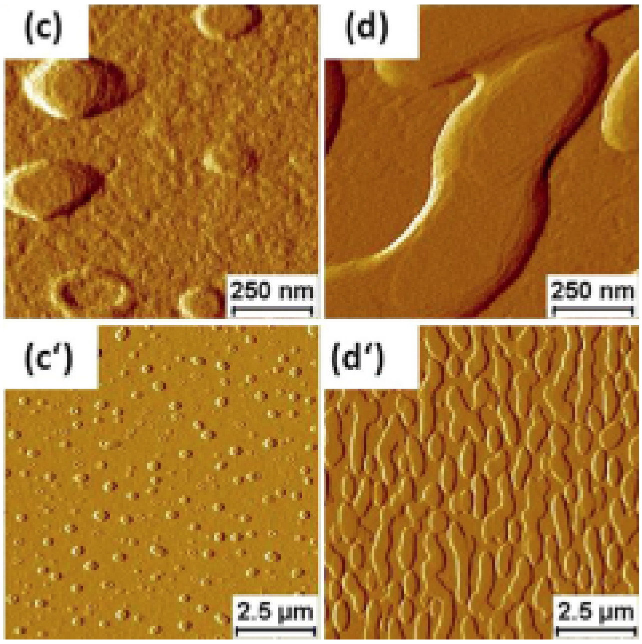

Figure 1:

Figure 1. Representative examples from [3] (AFM) of Volmer-Weber physics in the lattice matched InP/AlInAs system. Panels c,d are obtained with different InP coverage. In lower panels a larger area was scanned

[1] A. L.-S. Chua, E. Pelucchi, A. Rudra, B. Dwir, and E. Kapon, A. Zangwill, D. D. Vvedensky, Appl. Phys. Lett. 2008, 92, 013117.

[2] V. Dimastrodonato, E. Pelucchi, and D. D. Vvedensky, Phys. Rev. Lett. 2012, 108, 256102.

[3] Agnieszka Gocalinska, Marina Manganaro, Gediminas Juska, Valeria Dimastrodonato, Kevin Thomas, Bruce A. Joyce, Jing Zhang, Dimitri D. Vvedensky, and Emanuele Pelucchi, Appl. Phys. Lett. 2014, 104, 141606.

[4] A. Ozcan-Atar, A. Gocalinska, P.P. Michalowski and E. Pelucchi, Compound Semiconductor week, CSW-2021 online conference, 2021, May 9-13,

Primary author: Dr PELUCCHI, Emanuele (Tyndall National Institute, University College Cork)

Co-authors: Dr GOCALINSKA, Agnieszka (Tyndall National Institute, University College Cork); Dr OZCAN-ATAR, Ayse (Tyndall National Institute, University College Cork)

Presenter: Dr PELUCCHI, Emanuele (Tyndall National Institute, University College Cork)

Session Classification: MS

Track Classification: Interplay between Crystal Growth and Advanced Characterizations for Materials Development