Tailoring Semiconductor Growth with Light

K. Alberi[1]

[1] *National Renewable Energy Laboratory, 15013 Denver West Parkway, Golden, CO 80401 USA.*

The development of new semiconductor materials, heterostructures and interfaces critically relies on our ability to direct their synthesis. Vapor phase epitaxy methods generally allow crystal growth to be controlled to a high degree through parameters such as substrate temperature, atomic or molecular fluxes and substrate properties (crystallographic orientation, atomic step density, etc). Yet, these parameters alone may not always provide sufficient degrees of freedom to regulate the resulting material phase, compositional profiles and defect populations. Here we examine the mechanisms by which photons can affect semiconductor growth processes and may thus be used as an independent, externally controlled growth parameter. Many of the changes are driven by the influence of excess free carriers on adatom incorporation and desorption processes or a change in the electron potential at the growth surface. We discuss our recent work on how light can be used to address two specific growth challenges: 1) the incorporation of large Bi atoms into GaAs [1] and 2) the formation of heterovalent GaAs/ZnSe interfaces [2]. Based on our understanding of photo-assisted growth mechanisms, we also highlight other areas where light may provide additional control over end material properties.

[1] D.A. Beaton, A. Mascarenhas and K.Alberi, *J. Appl. Phys*., **118**, 235701 (2015)
[2] K. Park and K. Alberi, *Scientific Reports*, **7**, 8516 (2017)

[+] Author for correspondence: Kirstin.Alberi@nrel.gov