GaSbP synthesis by the Halide Vapor Phase Epitaxy technique: experiments and simulation

S. J. Calero-Barney[1], A. Martinez-Garcia[1], W. Paxton[2], M. K. Sunkara[1,2]
[1]*Chemical Engineering Department, University of Louisville*
[2]*Conn Center for Renewable Energy Research, University of Louisville*

Abstract

III-V semiconductor materials have been successfully used in power electronics, solar cells among different applications due to their tunable bandgap and the possibility to grow low-defect epitaxial films though Metal Organic Vapor Deposition or Molecular Beam Epitaxy, achieving materials with long charge carrier lifetimes and high mobilities.

The current challenge remains in the development of less expensive synthesis methods yielding higher growth rates while maintaining the high-quality characteristics or the afore mentioned methods. Halide Vapor Phase Epitaxy has shown good results when used for the synthesis of GaN and GaAs exhibiting growth rates in the order of microns per hour at near to atmospheric conditions, and therefore has been chosen as the focus of this study for the development of a ternary alloy, made by the incorporation of Antimony in the Gallium Phosphide lattice, as previous studies have shown this ternary alloy has a tunable bandgap, ranging between 1.7eV and 2.2 eV dependent on composition, making it suitable for solar cells or photoanodes in water splitting.

Our experimental results show that the growth mechanism of GaSbP is dependent on processing variables, such as the substrate temperature and the Ga/PCl3 ratio, and the simulations using the Chemkin module of Ansys Pro, have been useful to determine that the halide phase species are in supersaturated condition and most likely responsible for the growth, while the predicted growth rates are in the same order of magnitude of the films obtained experimentally.

Biography of Presenter

Sonia obtained her bachelor's and master's degrees in Chemical Engineering from Universidad del Valle and Universidad de los Andes in Colombia, respectively. During her Master she began studying semiconductor materials for solar water splitting, as renewable energy resources have always been of interest for her. In 2016 she joined the CVD Group to pursue her PhD degree at the University of Louisville where she is currently working on the synthesis of novel III-V alloys to be used in photo-electrochemical applications.