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GROWTH OF NEW EPITAXIAL SEMICONDUCTING ALLOYS

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The metalorganic vapor phase epitaxy of semiconductor materials has been developed over the past three decades and has focused on the formation of semiconductors and alloys useful in the formation of optoelectronic and high-speed electronic devices. These materials are generally binary semiconductors or alloys that have broad miscibility. The extension to alloy systems that are immiscible in bulk form requires modification to conventional growth systems preventing the nucleation and growth of multiple compositional phases. The formation of these multi-component alloys is discussed in terms of their known thermodynamic behavior which can be altered by the presence of strain in the material and the growth temperature. Additionally, the stoichiometry and reaction kinetics of the alloy constituents can impose kinetic constraints allowing for the formation of alloys within the miscibility gap. This talk will review and discuss those influences in determining the film composition and microstructure of the model alloys GaAsSb and GaAsN, which have both thermodynamic and chemical kinetic influences on the formation of the alloy. Additionally, there are new materials such as GaAsBi and Sb-N alloys that extend the range of device opportunities provided they can be synthesized in stable and homogeneous forms. The extension of this work to more complex alloys, such as 5 element or quinternaries, which open the palette of device materials, will be discussed along with some recent applications of these materials to optical and energy-related devices.