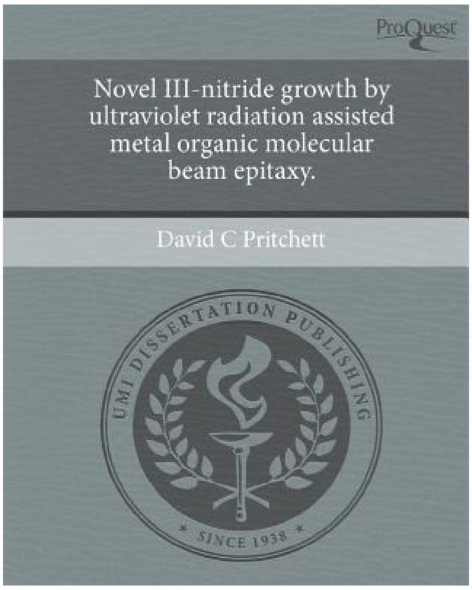

Novel III-Nitride Growth by Ultraviolet Radiation Assisted Metal Organic Molecular Beam Epitaxy

David C Pritchett

While modern epitaxial methods enable precise, monolayer (ML) control of the thin film deposition process, the complexity of certain device structures is ultimately limited by the capability and cost of the fabrication process. The objective of this work is to develop a pathway toward three-dimensional epitaxy (3DE)---the ability to intentionally and dynamically pattern regions of a film during the deposition process---in order to enable novel device concepts unbound by the traditional device fabrication paradigm. This work pioneers UV-assisted metal organic molecular beam epitaxy (MOMBE) as a particularly selective epitaxy technique to create a pathway toward 3DE of a crucial and topical material system---the III-Nitrides. A novel UV-assisted MOMBE system is developed enabling intense UV irradiation of films during growth. High quality, heavily (unintentionally) carbon-doped GaN is successfully grown by NH3-based MOMBE and for the first time InGaN, AlGaN, and magnesium-doped GaN are demonstrated by NH3-based MOMBE. Intense UV irradiation of films during NH3-based MOMBE significantly enhances photo-desorption of species during the growth process, subsequently affecting the resultant InGaN alloy composition, carbon dopant concentration, or magnesium dopant concentration. A digital micromirror device is introduced to pattern incident UV radiation during InGaN growth, demonstrating that the effects of photoexcitation during MOMBE which have been proposed, discovered, and identified by this thesis indeed can be leveraged to deposit an InGaN film that is compositionally patterned within the growth plane. The results demonstrate that the new approach presented herein is possible for the 3DE of III-Nitrides if additional challenges in practical implementation can be overcome.