Discovery of Topological States in InN Quantum Dots

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Background/Relevance

- The prediction that InN thin films may become a two-dimensional (2D) topological insulator results in increasing the research interest of InN.
- Topological insulator can be utilized as quantum bits “qubits” in order to manage quantum information which would provide a potential improvement of quantum computing.

Innovation

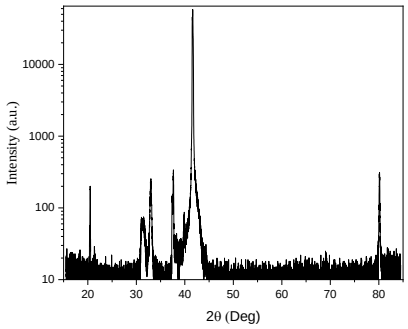
- Explore a novel growth technique of InN QDs.
- Investigate the topological state in InN QDs.

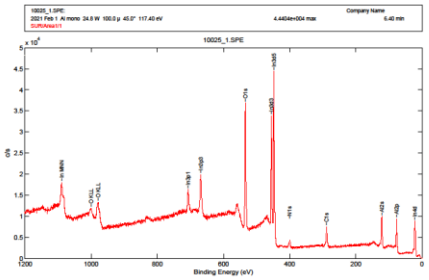
Approach

- Grow InN QDs using MBE.
- Grow a low temperature GaN layer to cap InN QDs either through MME or conventional growth techniques in order to protect the InN QDs.
- Photoluminescence is used to probe the QDs.
- Atom Force Microscope (AFM) measurements is used to understand of QD size and distribution
- Fabricate sub-micrometer metal apertures on the surface of the InN/GaN QDs using electron-beam lithography.

Key Results

- Grow several InN QD/Sapphire using droplet technique at different substrate growth temperatures.





XRD (right) and XPS (left) of InN QD grown at 400C and crystallized at 450C.

Conclusions

- Increasing the substrate growth temperature results in decreasing the dots' density and increasing the dots' height.
- To complete crystallization, the morphology of indium nitride QDs can be controlled by nitrogen flux and substrate temperature.

Future Work

- Grow InN/GaN QDs using MBE using droplet technique.
- Find good growth conditions for capping InN with epitaxial GaN.
- Measure photoluminescence emission from InN QDs.

Malak Refaei is supported by Jazan University through King Abdullah Scholarship program. Research is sponsored by DARPA-RA-18-01-PA-009