Toward strain control of magnetism in few-layer CrI_3

Student: Salem C. Wright Faculty Advisor: Dr. Hugh Churchill (PHYS)

Undergrad. School / Major: Presbyterian College / Physics

UNIVERSITY OF ARKANSAS
Graduate School & International Education
Microelectronics-Photonics

Nanoscience & Engineering

Microelectronics

Background/Relevance

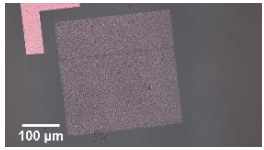
- The discovery of graphene ignited research into atomically thin materials, which can be manipulated to create new quantum devices dependent on the thickness of the materials
- CrI_3 is a known monolayer ferromagnet that can be cleaved into atomically thin layers for use in quantum devices
- It is predicted that biaxial compressive strain of CrI_3 will result in the formation of a quantum spin liquid, which is useful for quantum computing

Innovation

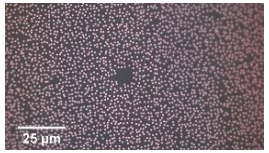
- Biaxial strain of few-layer CrI_3 will be used to tune its Curie temperature

Approach

- Create a polypropylene substrate with a speckle pattern using electron beam lithography
- Exfoliate thin flakes of CrI_3 onto a silicon substrate
- Use optical contrast techniques to measure the thickness of exfoliated layers
- Transfer few-layer CrI_3 onto a polypropylene substrate to apply compressive biaxial strain
- Future work will use an optical cryostat to measure the Kerr rotation of few-layer CrI_3 to determine the Curie temperature



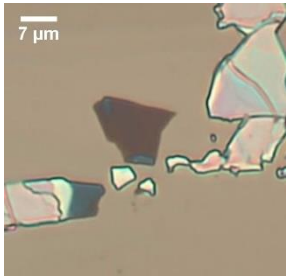
- Speckle pattern on a polypropylene substrate



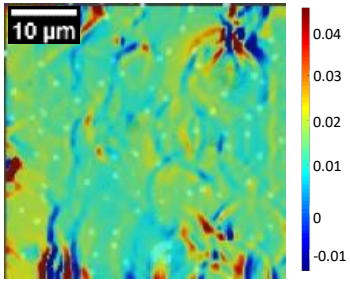
- Speckle pattern at a higher magnification

Key Results

- The thickness of few-layer CrI_3 flakes was measured using optical contrast
- Biaxial strain of polypropylene substrates was measured using digital image correlation



- Few-layer CrI_3 flake on a silicon substrate



- Strain plot, E_{xx}, of polypropylene measured using digital image correlation

Conclusions

- The thickness of few-layer CrI_3 can be measured using optical contrast
- The biaxial strain of polypropylene can be quantified using digital image correlation
- CrI_3 flakes can be transferred from a silicon substrate onto a polypropylene substrate for compressive biaxial strain

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