

Fracture and toughness analysis of CNT network interphase properties in DRY Buckypaper membrane Using Atomic Force Microscopy.

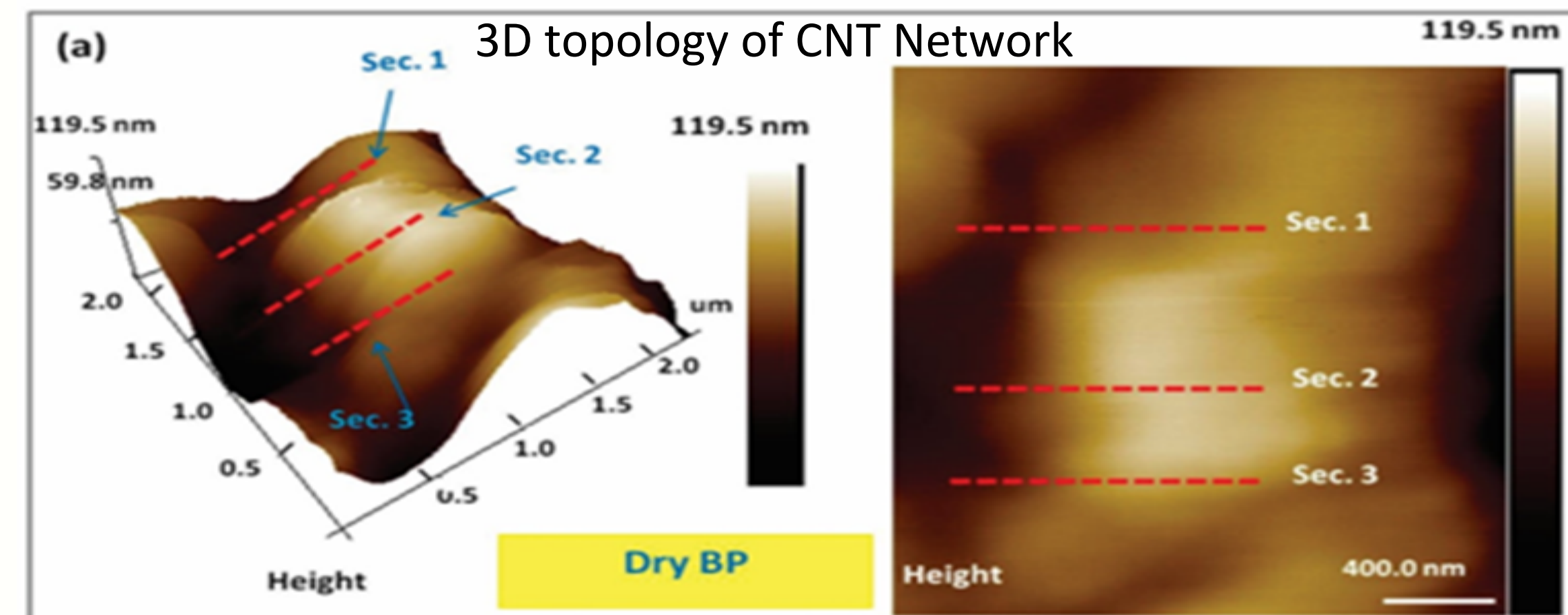


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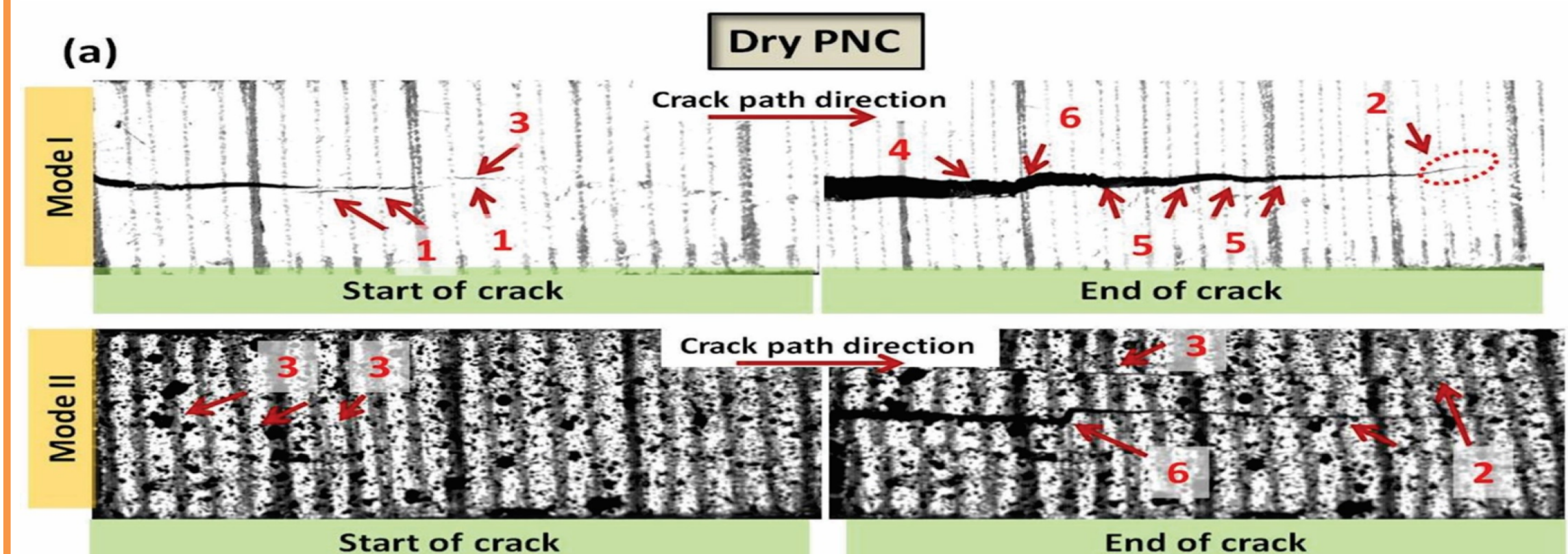
Abstract

The purpose of this research is to understand the macroscale fracture toughness of CNT network interphase in **DRY** Buckypaper (BP) at the nanoscale level using Atomic Force Microscopy (AFM). **DRY** BP, the focus of this research, doesn't consist of pre-infusion and is directly sandwiched by carbon fiber during the fabrication process. The objective of this study is to describe the effect of interphase properties on fracture toughness at a nanoscale level of **DRY** CNT BP membrane

Data Analysis



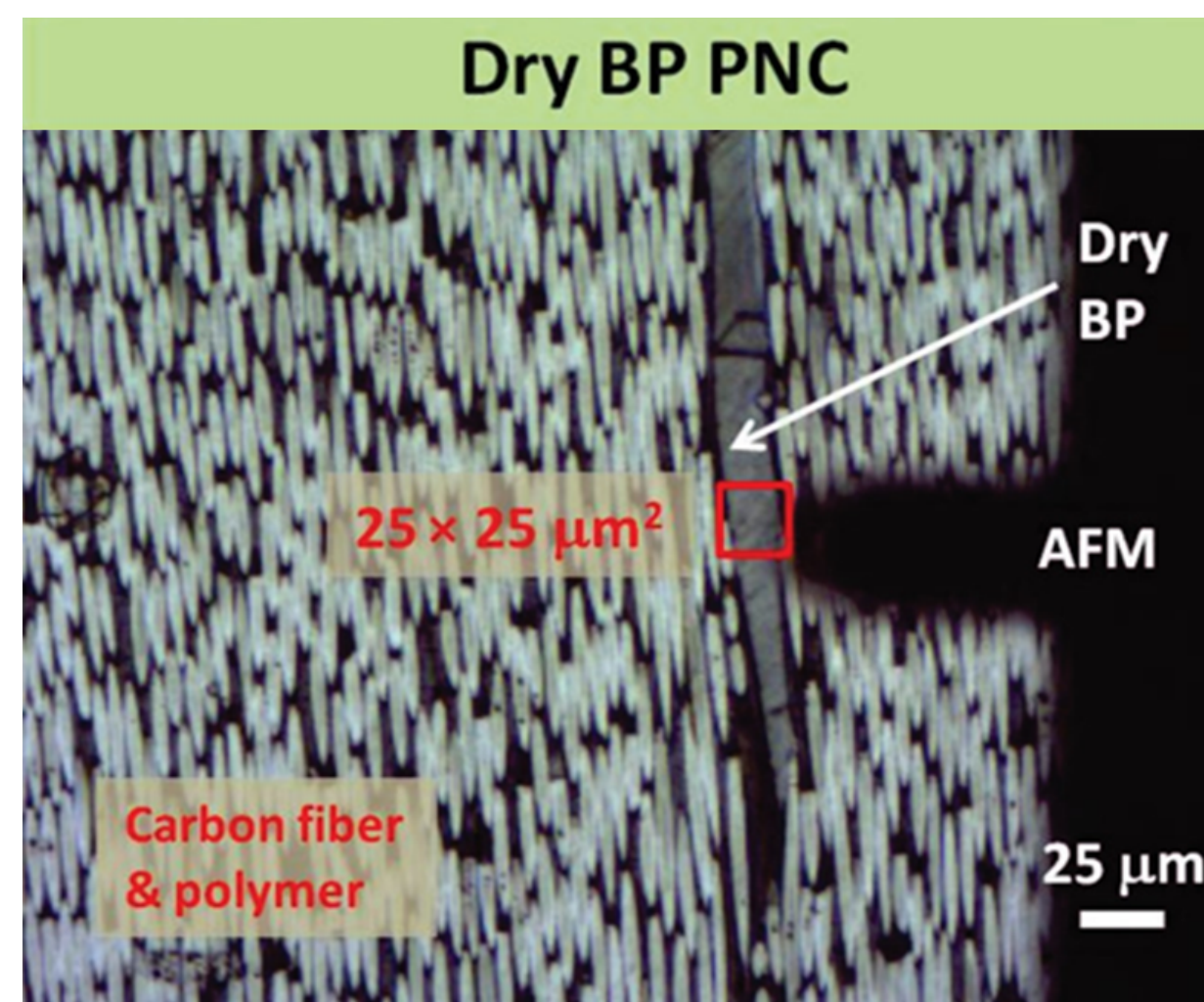
Results



- Damage Mechanisms
- 1 multiple cracks
 - 2 double cracks
 - 3 micro crack
 - 4 macro fiber bridging
 - 5 minor crack deflection
 - 6 major crack deflection
 - 7 separation

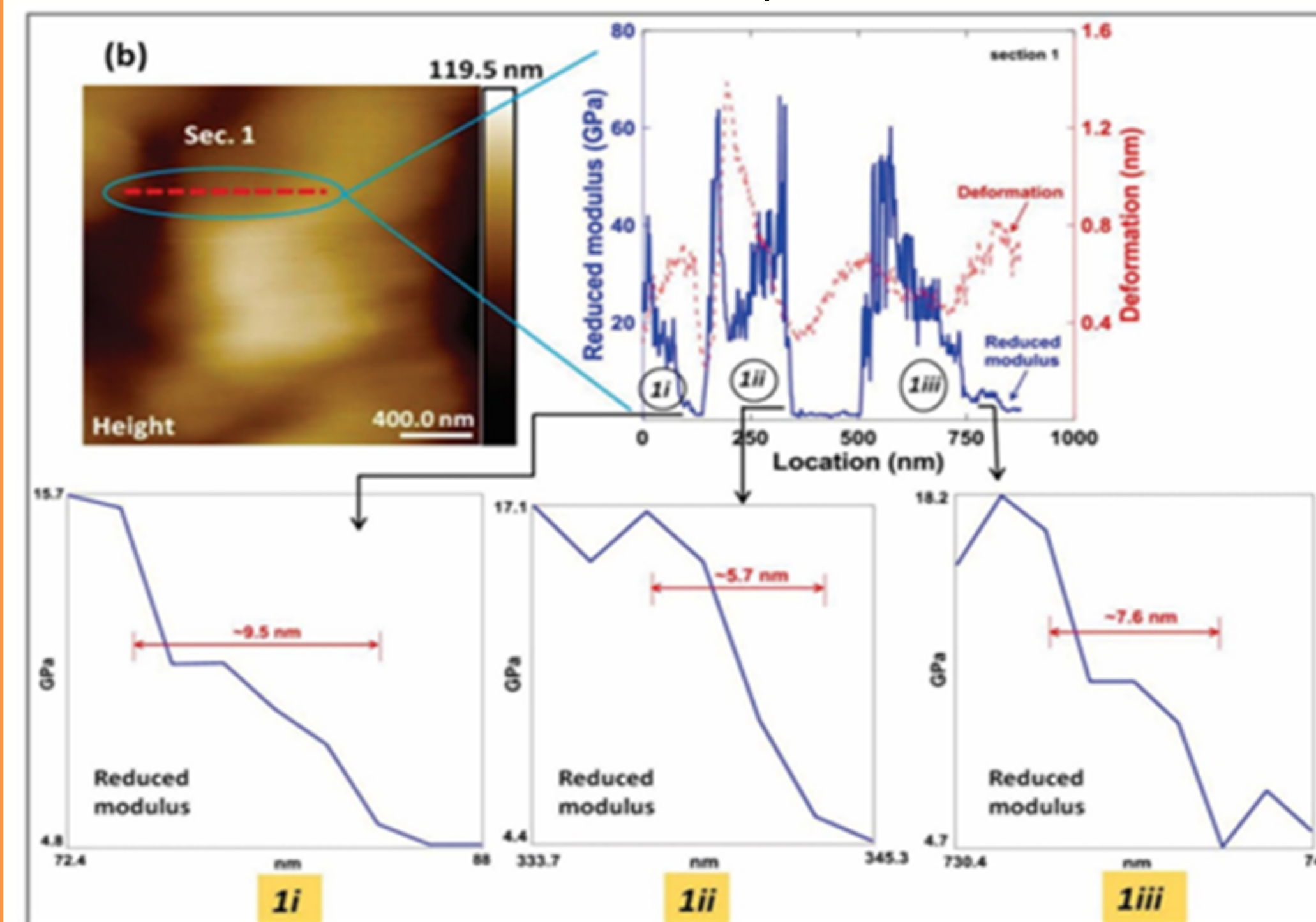
- Side of sample analyzed from start to end of crack.
- Mode I and mode II analysis completed.
- New minor and major crack deflection damage mechanisms discovered using BP material.
- As crack propagates around CNT network clusters major crack deflection occurs.

BP Analysis



- Dry BP sandwiched in polymer composites under optical microscope.
- Buckypaper thickness is 25 microns.
- Buckypaper used as crack arrester.
- Red boxed section chosen for AFM analysis.

2D section analysis



- Looking at regions which show high to low reduced modulus values allows for length of interphase region to be calculated.
- Interphase regions calculated for 3 regions located at sec. 1.

- 1000nm length of CNT network analyzed at sec. 1
- Based on AFM analysis graph created of reduced modulus (blue curve) and deformation (red curve) as function of distance.
- Modulus varies from high values above 15 GPA to low values 4-5 GPA.
- High reduced modulus values show areas with large CNT concentration.
- Low reduced modulus values show areas with less CNT network dispersion.

Accomplishments

Paper presented at ASME IMECE International Conference 2022.

References

Yekani Fard, M., Perrino, S., and Hedman, C. "Stochastic analysis of the carbon nanotube network interphase in dry and pre-infused buckypaper," ASME 2022 International Mechanical Engineering Congress and Exposition, October 30 – November 03, 2022, Columbus, Ohio, U.S.A.