

科技部自然司111年度奈米科技創新應用計畫研發成果發表會

計畫名稱：開發製作難加工材料之超硬碳基奈米結構鍍層技術 (學門歸屬:奈米製程、檢測與機械 [M3004])
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High Value-added Materials Are Difficult to Machine

Machine Tool Global Market Size: 20Bn\$

Machine Tools Market at 2016-2021



Lightweight to reduce energy

Temperature and corrosion resistance for extreme environment



Nanostructured Carbon Coatings to Address Hard-to-cut

Unique Combination of
 Low Friction and High
 Wear Resistance

Hurdle

Peel-off

High compressive stress
 Low adhesion

Poor Toughness

Brittleness

Thermal Stability

High working temperature



Solutions

Multilayer

Reduce Compressive Stress
 Increase Toughness
 Enhance Adhesion of Inter-layers

Doping

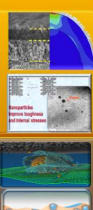
Reduce Compressive Stress
 Thermal stability can be increased

Graphene

Enhance Tribological Performance
 Reduce Working Fluid

Self-organized

Self Healing
 Reduce Working Fluid

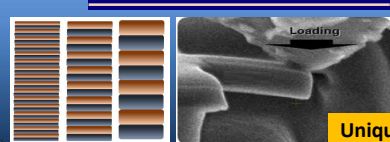


Multilayer Configuration

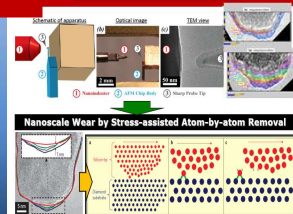
Computations/in-situ Characterization

In-situ TEM Nanowear Testing

Gradient Features



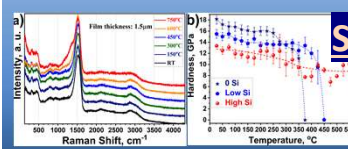
Unique Capability for Thin Film Adhesion Measurement



Thermal Stability

Co-Located Synchronized System

Si amount



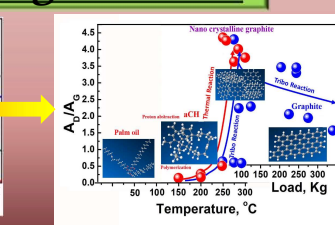
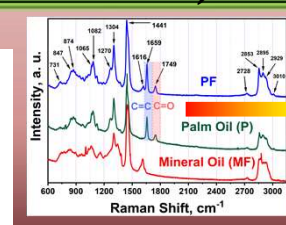
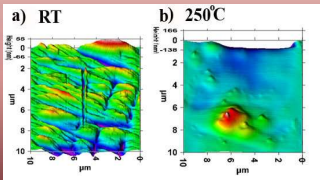
Si doping → films stable up to 600°C
 Great potential for high-temperature applications

Co-located Synchronized Raman-Indentation System



Self-generated Self-healing Tribofilm

Go Green (Reducing Mineral Oil & Toxic Additives) Using Palm Oil



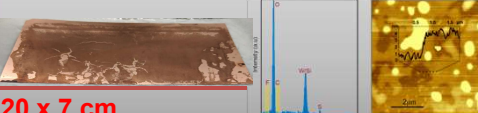
Self-Healing under Interfacial Temperature

Mechanism of Self-Assembly

Scaling Graphene Film Production

Technology Transfer

Field Test with Industrial Collaboration



20 x 7 cm

Additive-assisted Shear Exfoliation

Collaboration Company: 4

Royalty: NTD20,600,000

Publication

- Publication
- Carbon (Top Journal in Carbon Material): 4
 - Applied Surface Science (Top Journal in Thin Film Coating): 2
 - ACS nano: 1
 - Nature communications: 1
 - Nanomaterials: 3

