Residual Stress Induced Toughening in SiC Nanocomposite Coatings

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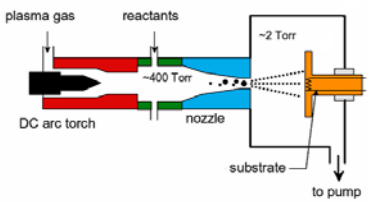
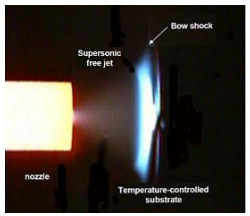
NNIN Facilities utilized: Characterization Facility & Nanofabrication Center

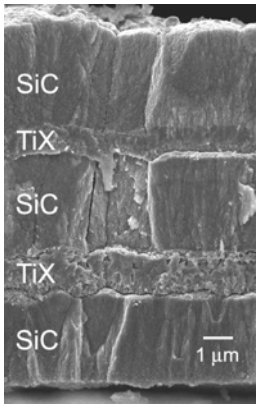
- DESCRIPTION OF WORK
  - Multilayered nanocomposite coatings were deposited using a hybrid process of nanoparticle impaction and chemical vapor deposition.
  - Consecutive deposition of SiC and TiX layers creates a film with layers of crystalline SiC nanoparticles embedded in a crystalline SiC matrix followed by Ti/TiO_2/TiC/TiO composite layers.
  - Nanoindentation was used to understand the elastic-plastic performance of the films.
  - Interlayer adhesion was studied with focus ion beam milled cross sections.

Deposition process

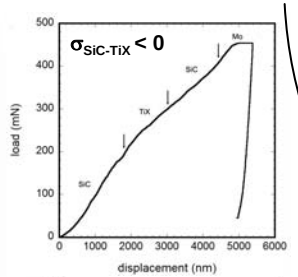


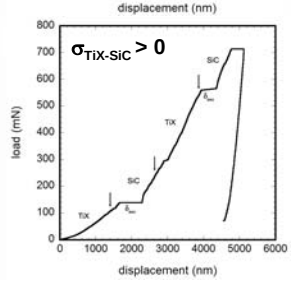


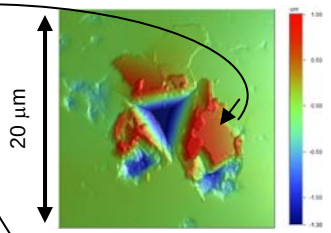
Microstructure

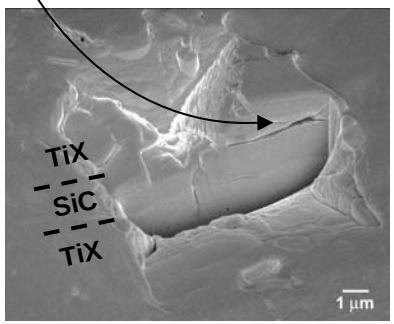


- MAJOR OBSERVATIONS
  - Both layers show an increased hardness without a change in the modulus compared to coarse-grained samples.
    - SiC: 37.4 ± 3.0 GPa and 380.3 ± 17.2 GPa
    - TiX: 19.4 ± 1.5 GPa and 283.6 ± 10.0 GPa
  - Interlayer delamination at TiX-SiC interface due to tensile residual stress









- Publications
  - A. R. Beaber, J. Hafiz, J. V. R. Heberlein, W. W. Gerberich, S. L. Girshick, *Surface and Coatings Technology* **203**, 771 (2008).
- Funding
  - NSF CTS-0506748