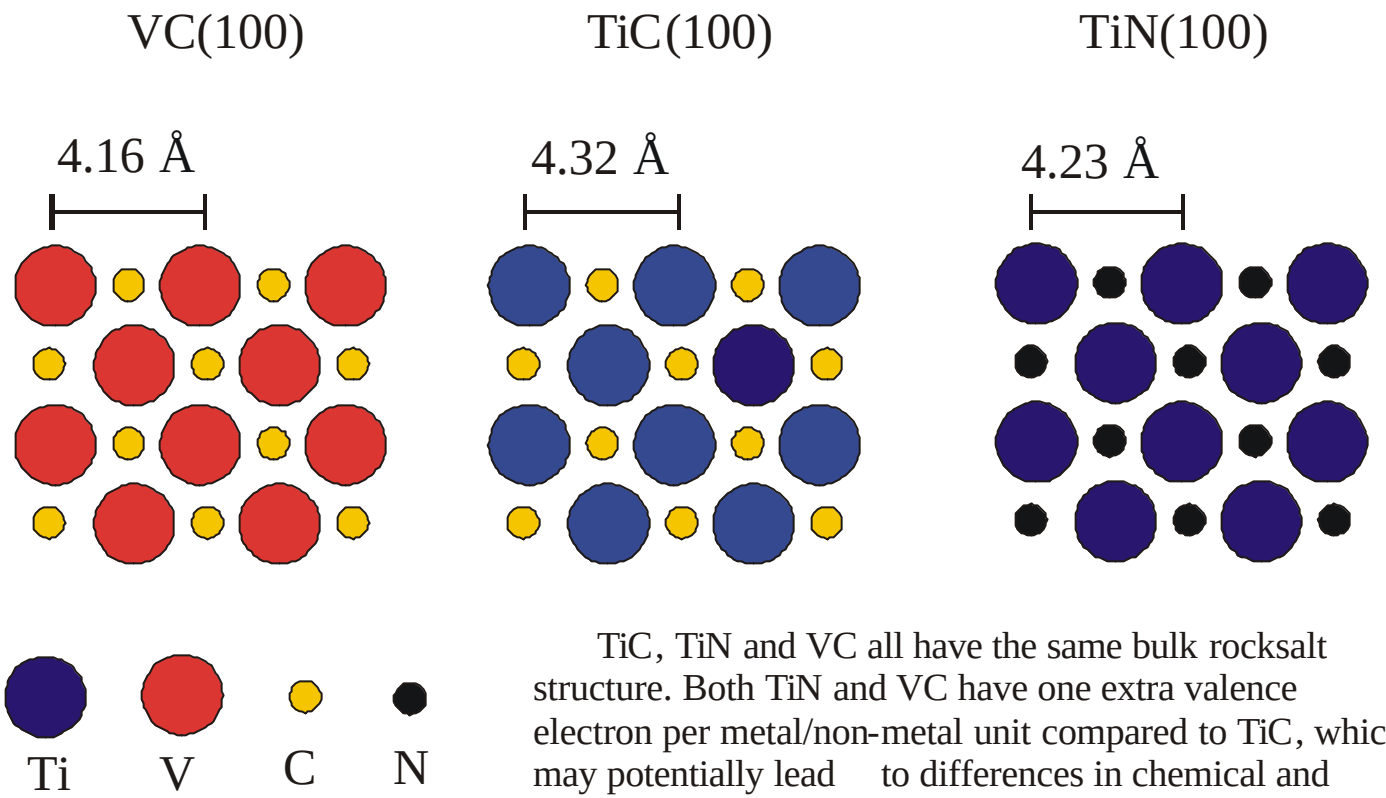
Scanning Tunneling Microscopy studies of TiC(001) and VC(100) surfaces

Structure of Single Crystal Metal Carbides & Metal Nitrides



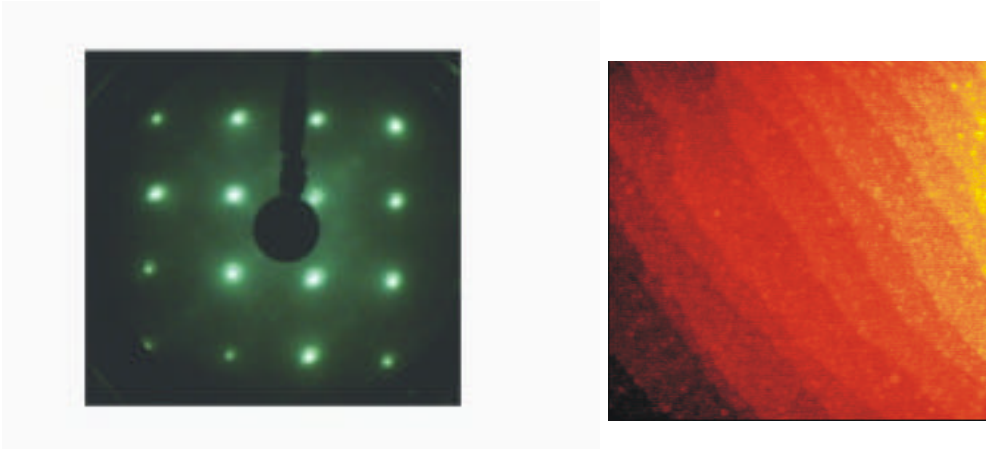
TiC, TiN and VC all have the same bulk rocksalt structure. Both TiN and VC have one extra valence electron per metal/non-metal unit compared to TiC, which may potentially lead to differences in chemical and tribological properties of these samples. In the current work, the non-polar (100) surfaces are chosen for comparison.

Surface Structure

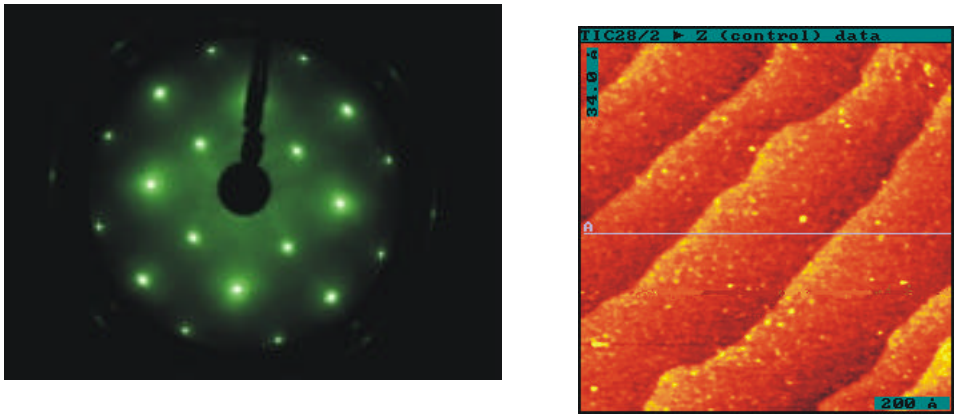
The surfaces of single crystal samples of titanium carbide and vanadium carbide exhibit a bulk termination and a step-and- terrace morphology.

Low Energy Electron Diffraction

Scanning Tunneling Microscopy Images

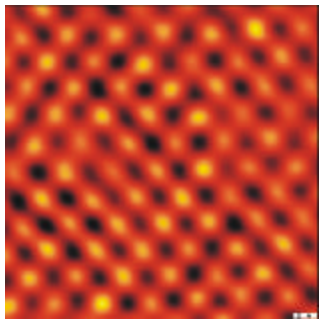


VC(100)

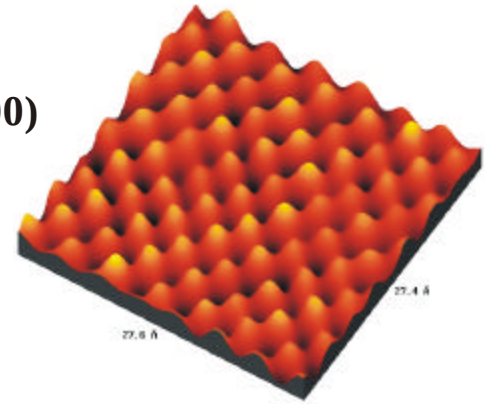


TiC(100)

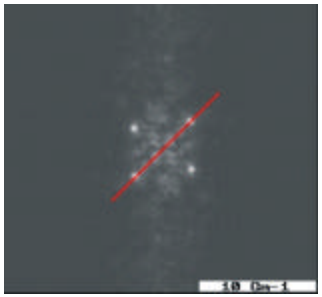
Atomic Scale Structure



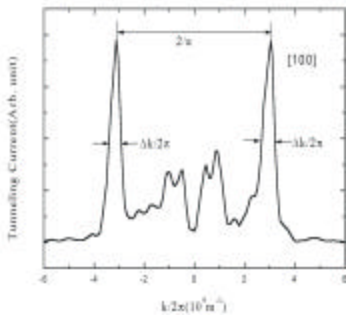
TiC (100)



These STM images reveal the ideal unreconstructed termination of the non-polar face of TiC(100). While an equal number of metal and carbon atoms are present, only sites associated with carbon are seen.



Ti-Ti, C-C distnce a = 3.05 Å
[110] direction: 3.20±2 Å
[10] dircetion: 3.002 Å

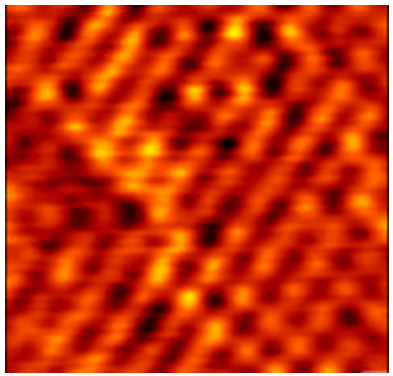


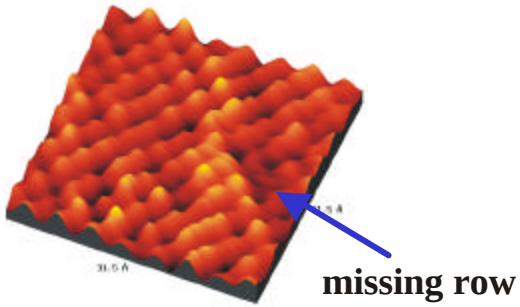
Analysis of these images provides structural parameters

Defect Structures : vacancies, Steps and Protrusion

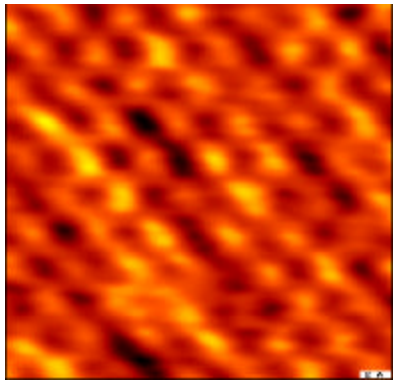
TiC (100)

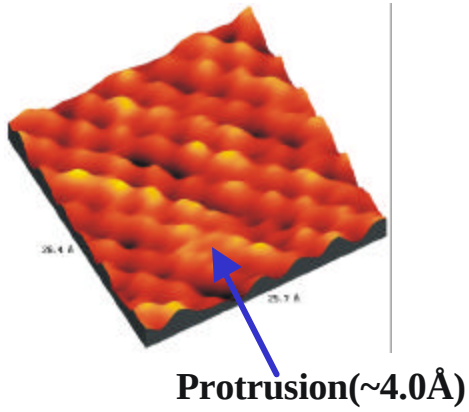
Vacancy





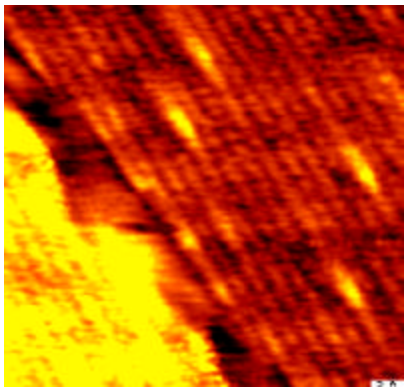
Buckling

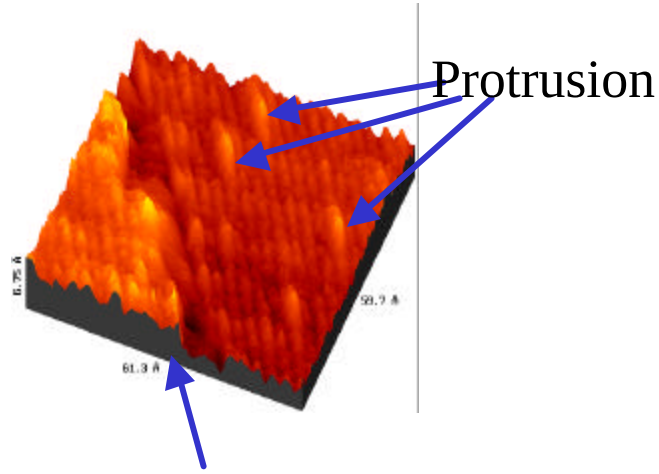




VC (100)

Atomic Step and Protrusion





Vacancy

Step

missing row