USUKI LAB.

[Development of High Thermal Conductivity Tool with Graphene]

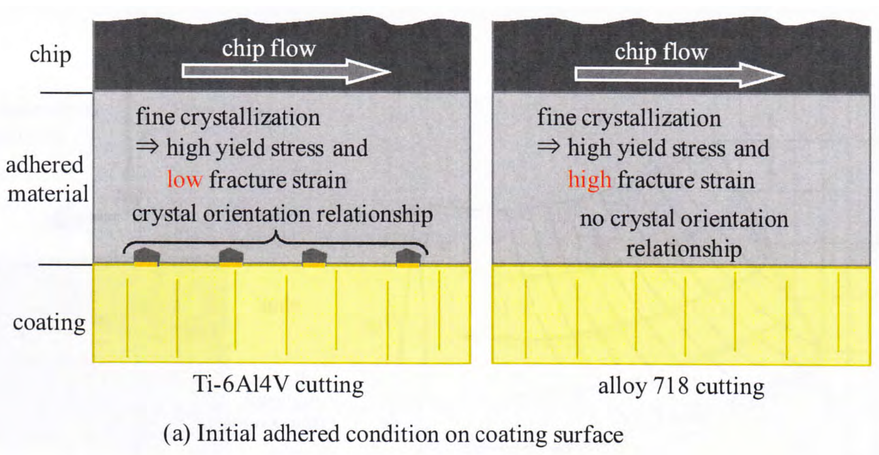
Department of Mechanical and Biofunctional Systems

Advanced Machining

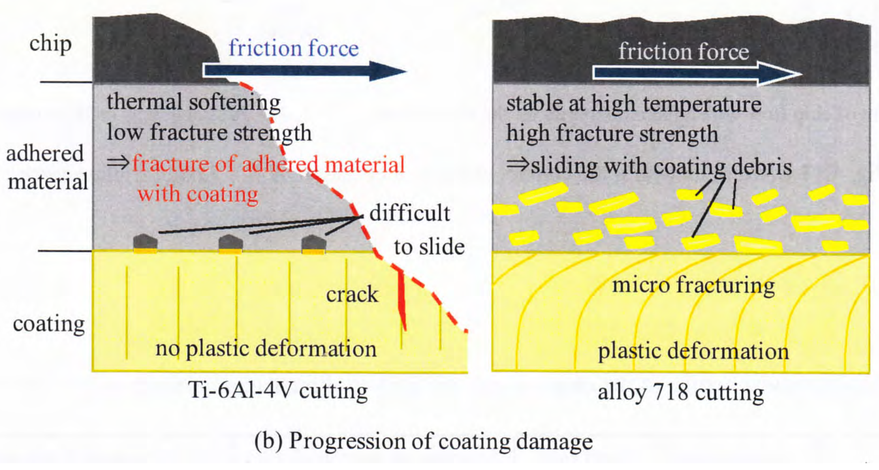
Department of Mechanical Engineering

Research assignment of cutting titanium alloy and superalloy

Surface of chip changes fine crystallization at interface between chip and coating
⇒～10 nm
・Crystal orientation relationship
・High Adhesive strength



(a) Initial adhered condition on coating surface



(b) Progression of coating damage

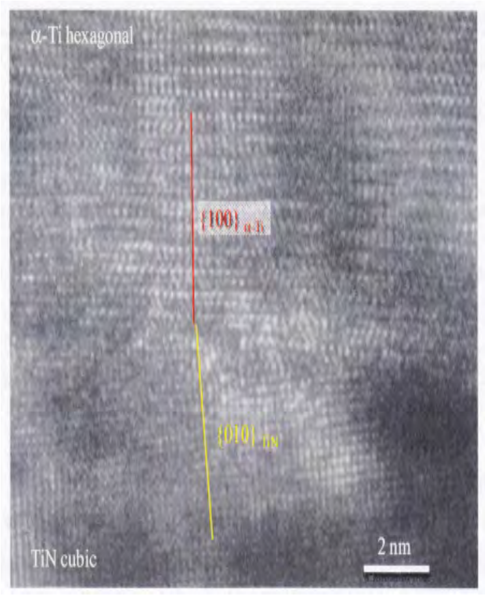
Wear processes of TiN coated tool when cutting Ti-6Al-4V and Inconel 718

High temperature
Low stress
plastic deformation of coating doesn't occur

①Crack occurs on adhered material by shear stress
②Crack spreads to coating layer
③Fracture of coating layer

Surface of chip changes fine crystallization at interface between chip and coating
⇒～100 nm
・No crystal orientation relationship
・Low Adhesive strength

High temperature
High stress
Surface of coating deforms and fractures



TEM image of interface between adhered material and TiN coating

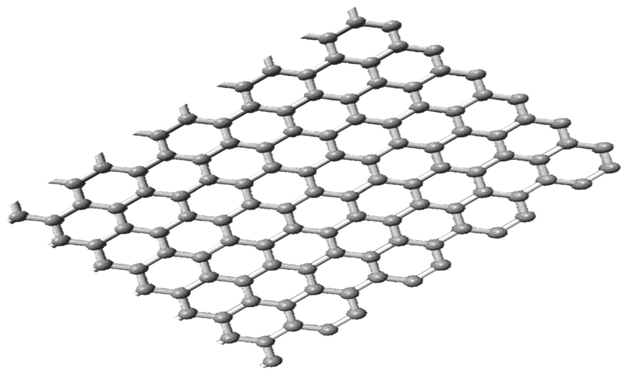
First step of adhesion between work material and tool is **fine crystallization of adhered material**
⇒Adhesion by interatomic force progresses tool wear

Development of High Thermal Conductivity Tool with Graphene

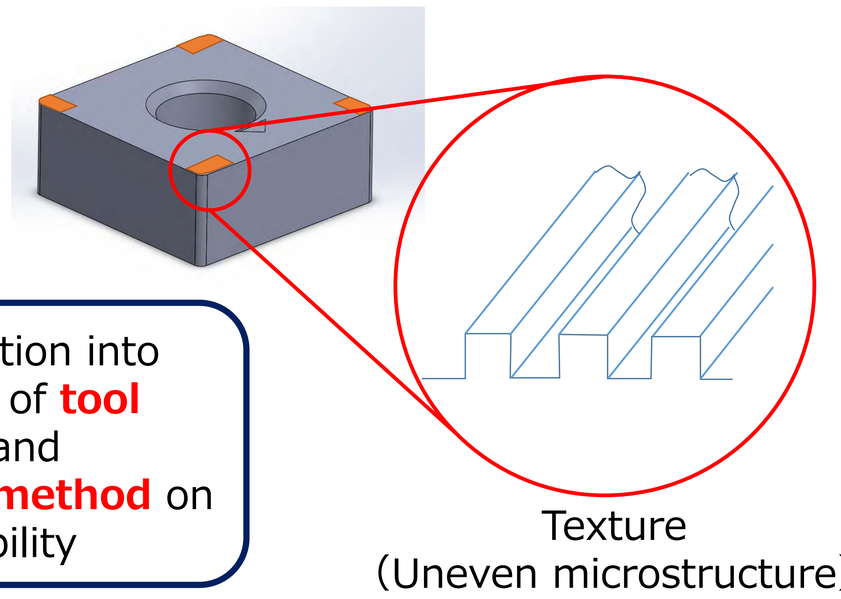
Key point are decrease cooling velocity of work material and cutting heat at edge of tool , to prevent fine crystallization
⇒One of the solutions, we try to **development of high thermal conductivity tool with graphene.**

SP2 structure
（Carbon nanotube and graphite have same structure）
⇒High thermal conductivity

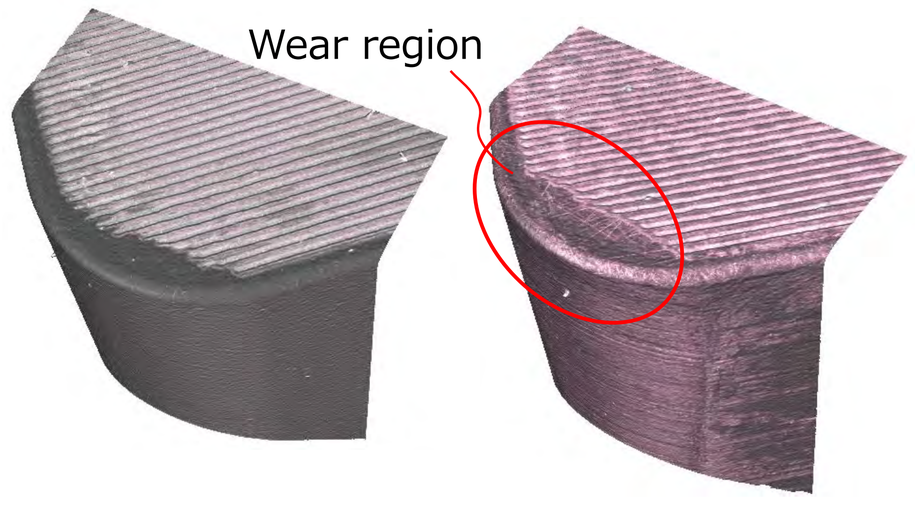
Ideal thermal conductivity 5800 W/m・K



Investigation into influence of **tool texture** and **coating method** on machinability



Texture
(Uneven microstructure)



Comparison between edge of tool before/after cutting