USUKI LAB.

[Development of High Thermal Conductivity Tool with Graphene]

Department of Mechanical and Biofunctional Systems
Advanced Machining

Research assignment of cutting titanium alloy and superalloy

Surface of chip changes fine crystallization at interface between chip and coating → \( \sim 10 \) nm
- Crystal orientation relationship
- High Adhesive strength

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

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

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 \( \cdot \) K

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

Investigation into influence of tool texture and coating method on machinability

Texture (Uneven microstructure)

Comparison between edge of tool before/after cutting