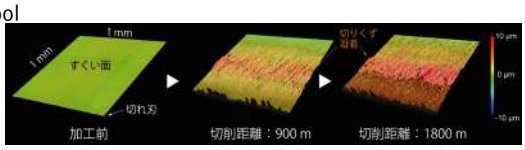
Development of High-performance Cutting Tools
with Laser Micro Texture

We manifest various functions by applying a periodic fine structure with an ultra-short pulse laser to tool surfaces from the perspective opposite to “finishing tool surfaces smoothly” that is the accepted practice of conventional cutting tools.

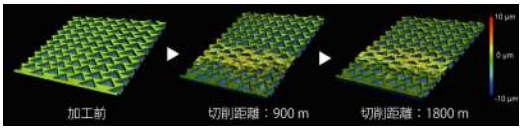
Suppression of Chip Adhesion in the Dry Cutting of Al Alloys

Comparison of the Amount of Adhesion at a Cutting Distance of 1,800 m

Normal tool

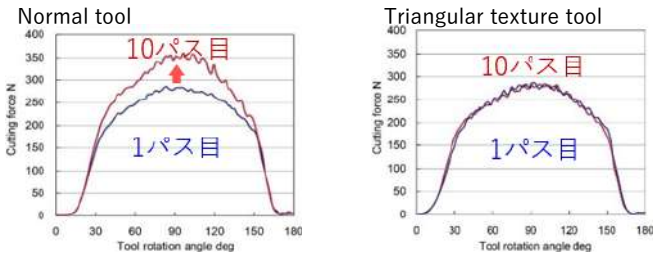


Triangular texture tool



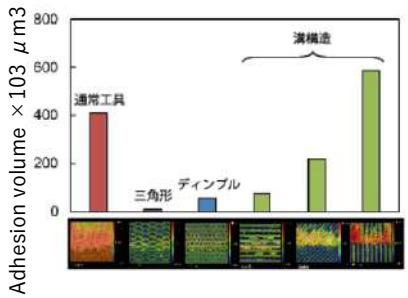
Adhesion resistance is improved remarkably by the application of a triangular texture.

Comparison of the Cutting Resistance



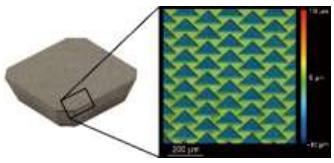
Triangular texture tools can suppress the growth of adhesion. Therefore, it is possible to semi-permanently maintain a cutting performance close to when in an unused state.

Results of an Adhesion Volume Comparison with Other Texture Tools



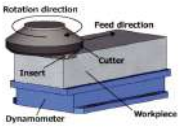
If the chip outflow direction and groove direction match, adhesion beyond that of normal tools occurs. The structure has an extremely strong directional dependence. In terms of function, the triangular texture is the most effective. However, dimple processing is amicable to eliminate directional dependence.

Production Tool Overview



Tool used: Sumitomo Electric SEKN42MT
Type of tool material:
Cemented carbide (non-coated)
Triangular base length: 155 μm
Triangular height: 80 μm
Dug height: 5 μm

Evaluation Method



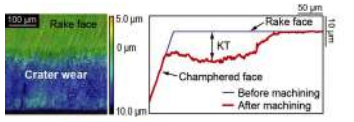
Cut material	Al alloy (A5052)
Cutting speed	380m/min
Feed rate	0.12mm/tooth
Notch	3mm

- Face miller cutter processing of an Al alloy (A5052) with a single blade
- Evaluated the amount of adhesion and cutting resistance at a cutting distance of 1,800 m

Reduction of Tool Wear in the Cutting of Steel Materials

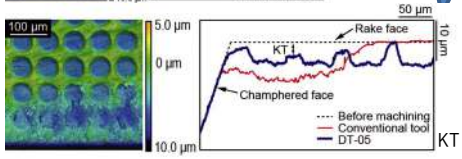
Comparison of the Amount of tool Wear

Normal tool



Approx. 60% wear suppression

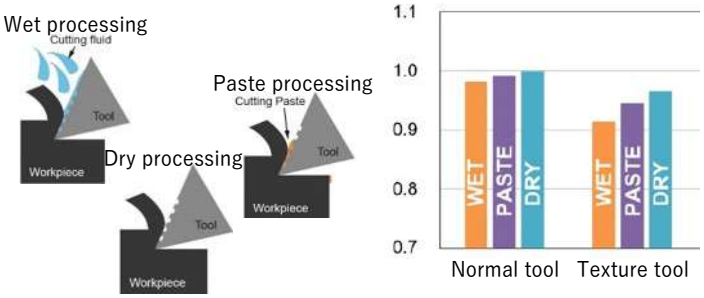
Texture tool



KT= Approx. 3 μm

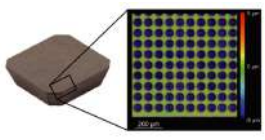
Suppresses crater wear over the enter rake face compared to normal tools
Dimples remain in the worn area at a cutting distance of 300 m

Comparison of the Friction Coefficient under Different Lubrication Environments



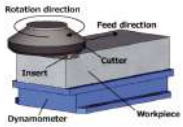
The friction coefficient is reduced under all lubrication environments

Production Tool Overview



Tool used: Sumitomo Electric SEKN42MT
Type of tool material:
Cemented carbide (non-coated)
Dimple diameter: 70 μm
Dimple pitch: 75 μm
Dimple depth: 5 μm

Evaluation Method



Cut material	Medium carbon steel (S53C)
Cutting speed	200m/min
Feed rate	0.20mm/tooth
Notch	2mm

Face miller cutter processing of a steel material (S53C) with a single blade
Evaluated the KT (maximum crater wear depth) at a cutting distance of 300 m

*This research was conducted as a joint study with the Enomoto Laboratory of Osaka University.
Enomoto Laboratory of Osaka University: http://www-cape.mech.eng.osaka-u.ac.jp/

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No.19-009-EN