

Exclusive Turning Cermet Grade “T1000A”

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Cermet tools have low reactivity with steel and other ferrous materials and are therefore used mainly for surface finishing. Sumitomo Electric Hardmetal Corporation has successfully developed a new cermet grade “T1000A” for turning. In recent years, high-feed or high-speed processing has been commonly used in manufacturing industries for process cost reduction. In this circumstance, cermet tools are desired to have stable performance and a long tool life. T1000A features excellent wear resistance and toughness resulting from the optimization of alloy composition. T1000A provides a high quality finished surface owing to optimized structure control, which was attained by our new sintering technology. Furthermore, T1000A is designed to be used for cutting not only steel but also cast iron and ferrous powder metal. This paper outlines the features of T1000A and its cutting performance.

Keywords: cermet, turning, finishing, cutting tool

1. Introduction

There are various materials available for indexable inserts that are used for cutting and processing metals. Among these, cermet is an important material mainly for finishing. This is because cermet has a carbonitride titanium-based phase hardened by means of a metal binder and accordingly has a low affinity for steel and other ferrous materials, enabling a high-quality finished surface.

Cermet is used for cutting mainly carbon steel and alloyed steel, which are important work materials in major industries including the transport equipment industry. Cermet is also used for finishing various types of work materials.

These days, an increasing number of cutting tool users require to improve their productivity and processing accuracy at low costs. Furthermore, due to the increased consumption and fluctuating prices of rare earth elements, there are high expectations for cutting tools that use a smaller amount of tungsten, a major element of cemented carbides.

In consideration of this situation, Sumitomo Electric Hardmetal Corporation has worked on the improvement of processing efficiency, particularly in finishing, and a tool life. We have developed a general purpose cermet “T1500A” for steel turning, a new general purpose coated cermet “T1500Z” using our original Physical Vapor Deposition (PVD) process, and a coated cermet “T3000Z” for the interrupted processing of steels.

Demand for faster and more efficient processing is likely to increase and the processing conditions will become harsher. This means that extending the life of cutting tools will be even more difficult. Furthermore, a wide variety of work materials are now used. In addition to steel, cast iron and ferrous powder metal are being processed with cermet tools.

In response to these market needs, Sumitomo Electric Hardmetal has released cermet “T1000A” for turning. With its high wear resistance, T1000A is suitable for steel, cast iron and ferrous powder metal processing. This paper mainly describes the features and cutting performance of T1000A.

2. Lineup of Our Cermet Grades

Figure 1 shows the lineup of our cermet grades for turning. Uncoated cermet T1000A and T1500A and coated cermet T1500Z and T3000Z can be used for all the kinds of processing from high-speed continuous processing to low-speed interrupted processing. T1000A is a P10 grade, which is highly wear-resistant even in high-speed continuous processing; T1500A and T1500Z are P20 general purpose grades for a wide range of processing from continuous processing to interrupted processing; and T3000Z is a P30 grade, which shows high fracture resistance even in interrupted processing.

T1000A has found a wider range of applications than conventional grades because of its improved wear resistance and fracture resistance. It shows performance that can be comparable to that of coated grades in some cutting conditions.

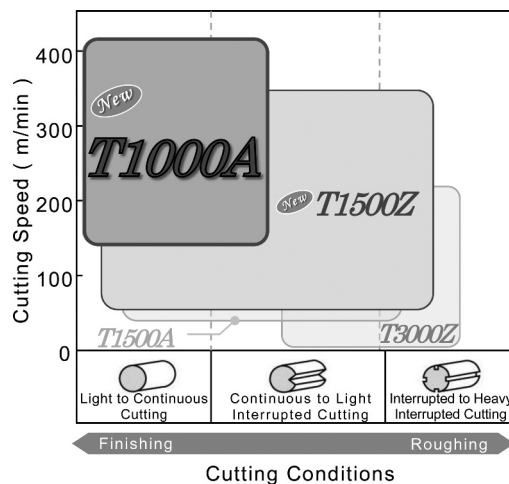


Fig. 1. Lineup and Application of Cermet Grades for Turning

3. Features of T1000A

3-1 Achievement of long life and stable processing capability

P10 grades are often used for continuous processing and light interrupted processing because they have a long tool life and high efficiency. This means that P10 grades need to have high wear resistance in cast iron processing than in steel processing. Although it depends on the material, more work material can be welded and adhere to the cutting tool when its processing speed is lower, increasing the fracture ratio. Therefore, T1000A with a high wear resistance is better suited for steel processing at $v_c = 100$ m/min or faster.

However, it is very important that T1000A maintains strength and high fracture resistance because it is exposed to heavy loads in high-speed processing, and also used in partially interrupted processing.

To improve fracture resistance while maintaining and improving wear resistance, we enhanced the cohesive strength of the constituent particles by adjusting the composition. At the same time, we optimized the sintering conditions to increase the hardness and the bending strength of the cermet itself, as shown in **Fig. 2**. As a result, we were able to develop wear-resistant and fracture-resistant T1000A with a long tool life and stable processing capability.

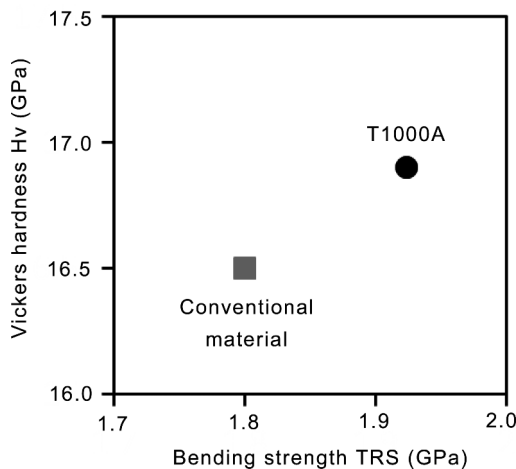


Fig. 2. Vickers hardness and bending strength

3-2 Achievement of superior worked surface

Cermet for today's commonly used tools includes tungsten as an additive to improve toughness and thermal conductivity, which are important properties for cermet. In some cases, however, the use of tungsten impairs one of the most valuable features of cermet, a low reactivity with steel.

To address this, we controlled the properties of the precipitated hard phase by optimizing alloy composition and sintering conditions while adding tungsten, as shown

in **Fig. 3**. As this enables reactivity with ferrous materials to be reduced, T1000A achieves high welding resistance as a strong point of cermet. Even when T1000A is used for cutting soft steel or ferrous powder metal, which is easy to be welded, T1000A produces a superior worked surface.

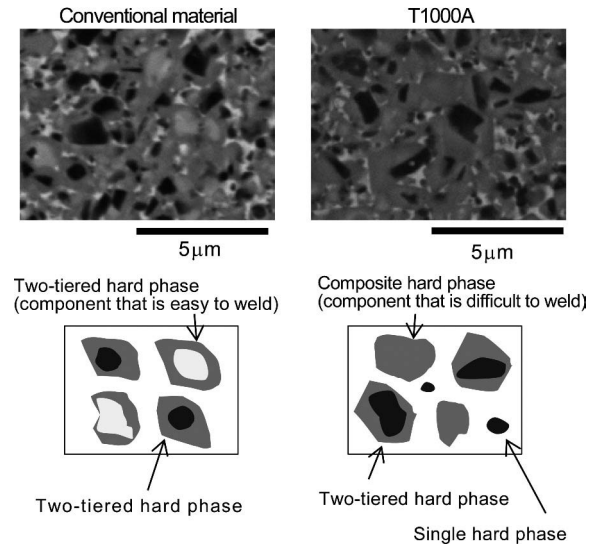


Fig. 3. Alloy composition (SEM Images and pattern diagrams)

3-3 Wide range of application

We have released more than 500 kinds of T1000A inserts to respond to various types of processing. Those include negative inserts used mainly for external turning and facing, and positive inserts used mainly for internal turning.

Furthermore, we have enhanced our lineup of inserts for grinding so that we can meet increasing needs for highly accurate processing.

4. Cutting Performance

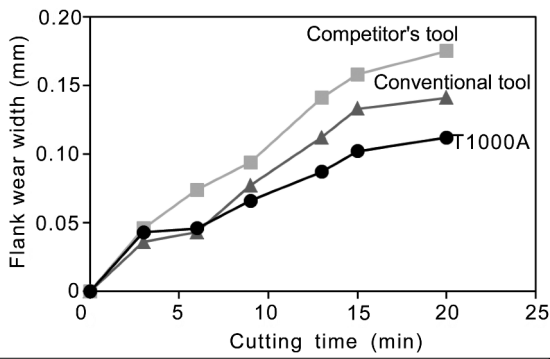
4-1 Wear resistance

T1000A has high wear resistance because it has higher hardness than conventional material grades. **Figures 4 and 5** show wear resistance evaluation results when T1000A is used for cutting alloyed steel, which is in high demand, and cast iron, respectively. T1000A demonstrates high wear resistance for both materials.

4-2 Fracture resistance

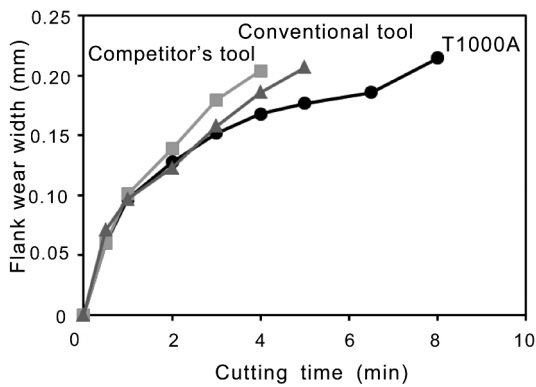
Cermet tools are used mainly for finishing. This indicates that they may be used for interrupted processing and any fracture is critical. As fracture resistance is very important for cermet, we performed a fracture resistance test with slotted work materials. **Figure 6** shows the results.

The results found out that T1000A has high fracture



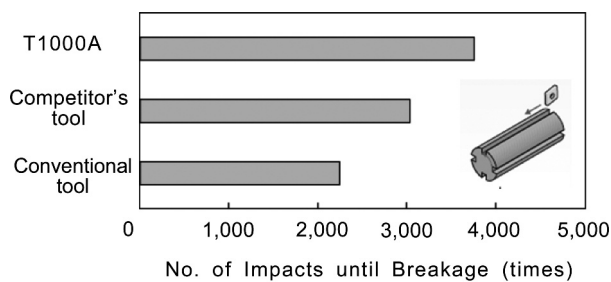
Insert: CNMG120408
 Work material: SCM435 round bar
 Cutting Conditions: $v_c=320$ m/min, $f=0.2$ mm/rev, $a_p=1.5$ mm, Dry

Fig. 4. Wear resistance evaluation (alloyed steel)



Insert: TNGA160408
 Work material: FCD700 round bar
 Cutting conditions: $v_c=70$ m/min, $f=0.2$ mm/rev, $a_p=1.5$ mm, Wet

Fig. 5. Wear resistance evaluation (cast iron)



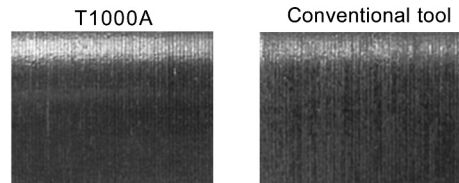
Insert: CNMG120408
 Work material: SCM435 interrupted material
 Cutting conditions: $v_c=230$ m/min, $f=0.2$ mm/rev, $a_p=1.0$ mm, Wet

Fig. 6. Fracture resistance evaluation

resistance and achieves stable processing because it has higher bending strength than that of conventional material grades.

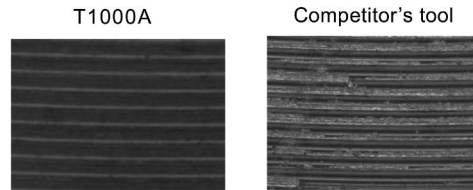
4-3 Worked surface quality

When work materials are finished with cermet tools, the quality of the worked surface is very important. Therefore, we evaluated finished surfaces when alloyed steel and ferrous powder metal work materials, which are easy to be welded, were processed with T1000A. Figures 7 and 8 show the worked surfaces, demonstrating that T1000A achieves excellent worked surfaces because of its low affinity with ferrous materials.



Insert: CNMG120408
 Work material: SCM415 round bar
 Cutting conditions: $v_c=150$ m/min, $f=0.15$ mm/rev, $a_p=0.5$ mm, Wet

Fig. 7. Worked surface evaluation (steel)



Insert: TNGG160408
 Work material: SMF4040 end surface
 Cutting conditions: $v_c=120$ m/min, $f=0.15$ mm/rev, $a_p=0.15$ mm, Dry

Fig. 8. Worked surface evaluation (ferrous powder metal)

5. Use Examples of T1000A

The following shows use examples of T1000A.

Figure 9 shows a use example in steel processing. Thanks to its high wear resistance, our T1000A tool achieves a two times longer tool life than a competitor's tool in the equivalent grade.

Figure 10 shows a use example of cast iron processing. The results found out that our T1000A tool has longer tool life than that of our conventional product for cast iron processing.

Finally, Fig. 11 shows a use example in ferrous powder metal processing. The results here also found out that our T1000A tool has longer tool life than that of our conventional product for ferrous powder metal processing.

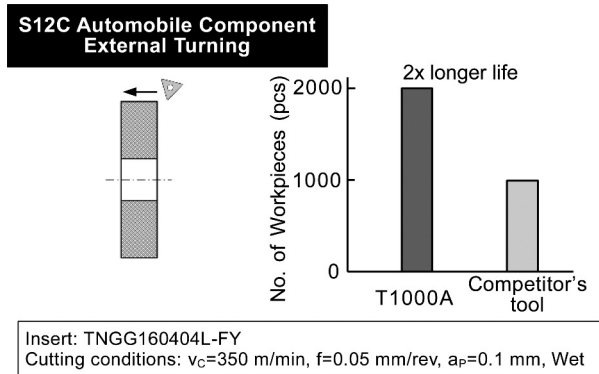


Fig. 9. Use example (steel processing)

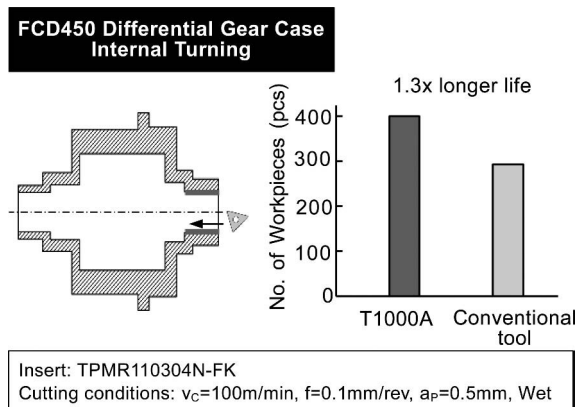


Fig. 10. Use example (cast iron processing)

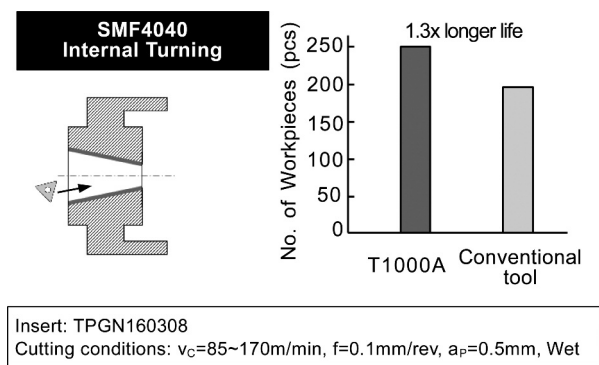


Fig. 11. Use example (ferrous powder metal processing)

6. Conclusion

T1000A with improved wear resistance and fracture resistance meets the market's needs. This grade material can be used not only for steel work materials but also for cast iron and ferrous powder metal work materials. We are con-

fidant that T1000A will contribute significantly to the improvement of productivity and reduction of tool costs.

Technical Term

*1 Cermet: "Cermet" is a portmanteau of "ceramic" and "metal." It is a composite material made by mixing and sintering a titanium-based hard compound and a metallic binding material.

Reference

- (1) Kazuhiro Hirose, Keiichi Tsuda, Yoshio Fukuyasu, et al., "Development of Cermet 'T1500A' for Steel Turning," Sumitomo Electric Technical Review 72, p.107-111 (2011).

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