LAAN-A-HN-E008

SHIMADZU

Application News

Material Testing System No.i221

Damage Evaluation for Cutting Tool (Tip) Edge by Micro Compression Testing Machine

■ Introduction

It is said that the edges of cutting tools are damaged or impaired by mechanical action (e.g. impact or abrasion caused by scratching by hard particles) or thermo-chemical action (e.g. abrasion caused by adhesion, diffusion or corrosion, fracturing caused by softening or melting of the cutting edge, thermal fatigue, and thermal cracking).
The development of even stronger cutting edges is being promoted to adapt to diversifying workpieces, and there is a need for a means for quantitatively measuring the strength of cutting edges to prove their strength.
As a proposed means for evaluating strength, a compression test was performed in the vicinity of the edge to measure the relationship between breaking strength and test force/displacement. The following introduces an example of this.

■ Testing machine and specimens

The testing machine used in this test was the "Shimadzu MCT-W500 Micro Compression Testing Machine" (overview shown in Fig. 1), which is generally used for compression tests where a load is applied by a flat compression plate on micro particles or similar specimens. Also, enlarged observations could be made from above (compression direction) using the length measurement kit provided with this testing machine.
Two cutting tools (tips) were used as specimens. (Here these are represented as specimen A and specimen B for identification purposes.)

Fig. 1 Overview of Shimadzu MCT-W500 Micro Compression Testing Machine

■ Test conditions

Generally, in regular compression tests, the load is applied on the specimen by inserting it between flat surfaces. However, in this test, a sharp-tipped triangular pyramid indenter (Berkovich indenter, used for hardness tests) was used to apply a point load that would simulate "force acting locally on the cutting edge of the specimen."
Fig. 2 shows a conceptual diagram, and Table 1 summarizes the test conditions (loading conditions).

Table 1 Test Conditions (Loading Conditions)

1) Testing machine	Shimadzu MCT-W500 Micro Compression Testing Machine (with Length Measurement Kit) (See Fig. 1)
2) Indenter	Triangular pyramid indenter with tip angle of 115° (made of diamond) (Berkovich indenter)
3) Loading method	Compression test
4) Max. force	4903 mN
5) Loading rate	103.705 mN/sec

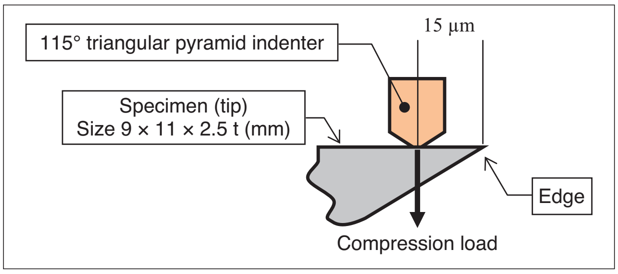

Fig. 2 Conceptual diagram (Side View)

Test results

Fig. 3 shows the results obtained by testing under the test conditions described above, in the form of a "force-displacement graph." As the load increases, the force and displacement (indentation depth) also increase. However, it can be seen that at a certain point this relationship becomes unstable (i.e. the increase in force becomes less than that in displacement) and breaking occurs.
From this, it can be seen that specimen B has a higher breaking strength than specimen A.
Furthermore, Fig. 4 shows observed images of the state of the cutting edge (specimen B) before and after the test (breaking) taken from above (load side) by the length measurement kit (equivalent to stereomicroscope).

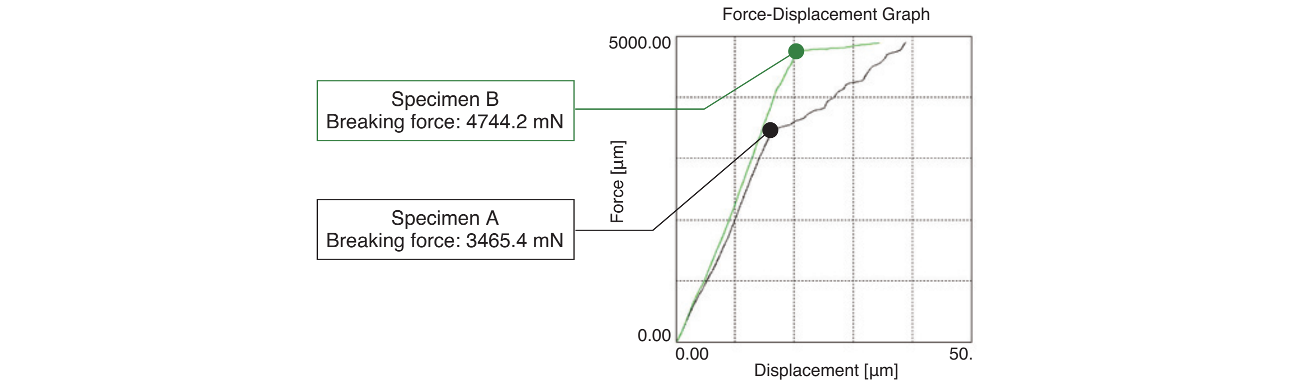

Fig. 3 Test Result (Force-Displacement)

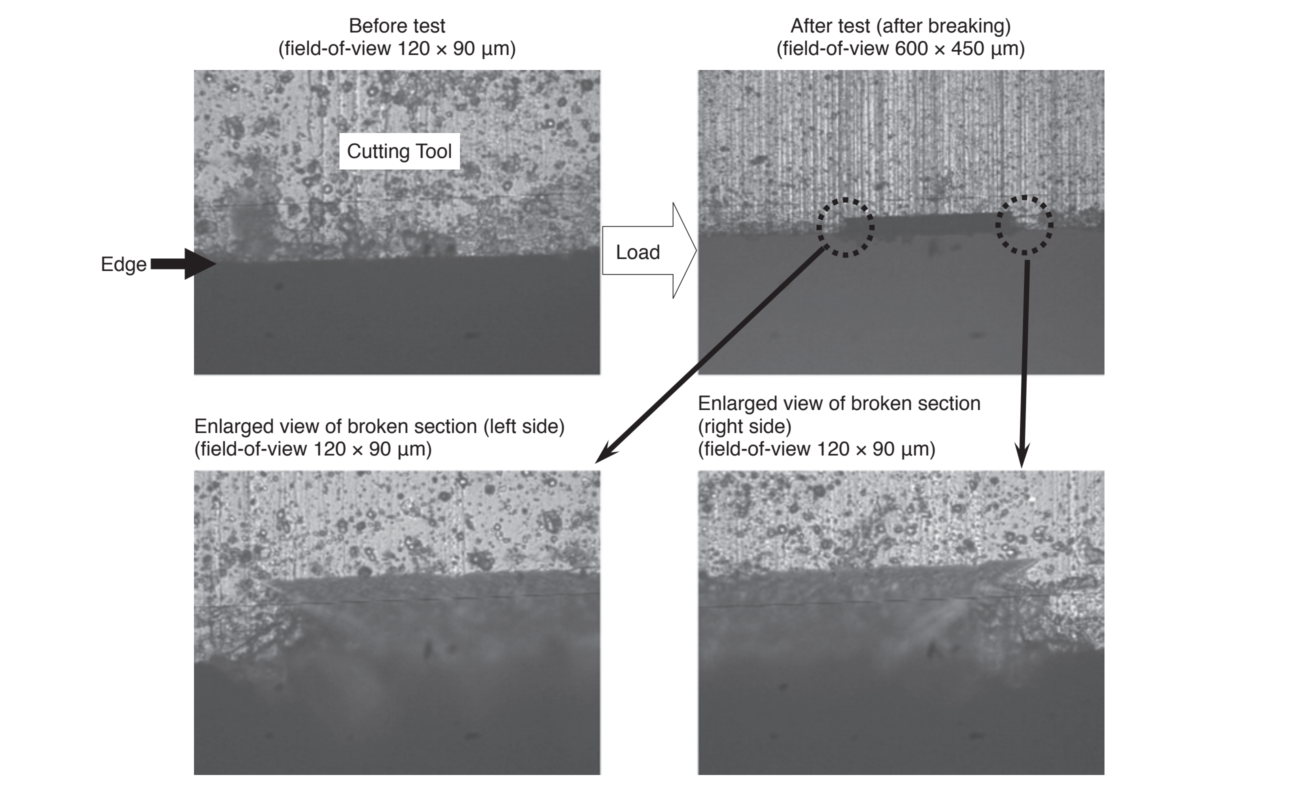

Fig. 4 Microscopic Images of Specimen

As can be seen from the above results (data) and images, when the Shimadzu MCT-W500 Micro Compression Testing Machine is used, valid mechanical properties can be obtained since loads can be applied at precise locations while enlarged images of the actual specimen are verified on screen.

SHIMADZU
SHIMADZU CORPORATION. International Marketing Division
3. Kanda-Nishikicho 1-chome, Chiyoda-ku, Tokyo 101-8448, Japan Phone: 81(3)3219-5641 Fax. 81(3)3219-5710
Cable Add.:SHIMADZU TOKYO