MSE

Features of MSE tester

Material, surface, interface, sub-micron layer unit, strength, accurate measurement

Objective

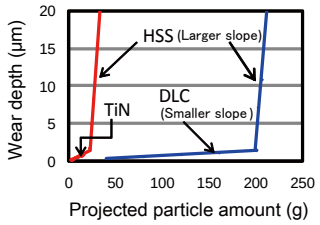
1. Hard coated thin film (DLC, TiN, CrN) single or multi layer, coating chip metal type surfaces
2. Rubber material, bulk film, functional rubber coating film
3. Metal (bulk, plate, heat process material) metallic wear resist metal part
4. Ceramic (sapphire, super-hard, diamond, CBN) sintered tool

MSE data characteristic

1 Film and substrate strength

A measurement on material that using same substrate but contain a different coated film such as DLC and TiN has been conducted. The result shows a huge different in wear progression (slope from graph) on TiN and DLC coated film.

MSE tester defined this slope as the wear rate.



Measurement result of DLC and TiN coated specimen

$$\text{Wear rate (μm/g)} = \frac{\text{Wear depth (μm)}}{\text{Projected particle amount (g)}}$$

Wear rate : Low ◢ High
Material strength : Stronger ◣ Weaker

The smaller wear rate shows the stronger material.

From the graph in case of wear rate

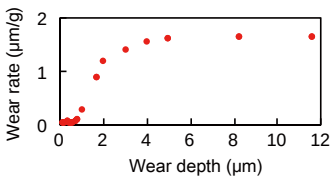
① DLC is more stronger compare to HSS.
Material strength **HSS < TiN < DLC**
1 : 30 : 250

② Both HSS substrate posses the same strength.

2 Material strength distribution (depth direction)

Easy-understanding visual of material strength from plotted wear rate graph through depth direction.

a TiN coated + substrate



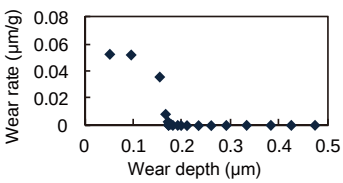
Wear rate distribution through depth direction

View point from the graph

① TiN coated thickness is about 1.5μm
[Wear rate : 0.06μm/g]

② The substrate wear rate is about 1.6μm/g

b DLC coated (1st layer interface until 0.5μm in depth)



Wear rate distribution through depth direction

View point from the graph

① Hard material can be found from the surface until 0.1μm deepness. [0.05μm/g]

② A very hard material can be found at 0.1μm deepness upward. [0.0004μm/g]

→At the DLC coated surface, weak film at 0.1μm can be notice.

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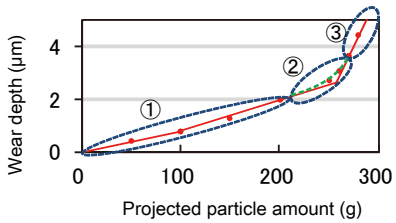
3 Film thickness

A thickness of a material can be notice from the wear depth and projected particle amount plotted graph.

(a) DLC coated

The thickness of material is identified from the change of wear rate strength.

As the MSE tester calculated wear rate from the graph slope, the graph is separated in 3 major parts that is film, interfaces and substrate.



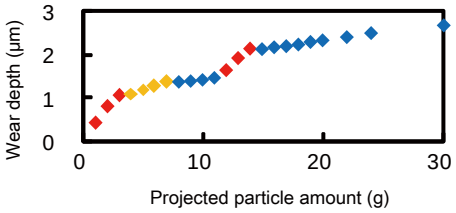
DLC coated cutting tool measurement result.

View point from the graph

①Film : 2μm in thickness.
②Interface layer : 1.5μm in thickness.
③Substrate : 3.5μm depth upward.

(b) Multi layer coated

As the MSE tester measuring material in sub-micro unit, it can be use for thickness identification for even ultrathin multi layer coated material.



Multi layer coated cutting tool measurement result

View point from the graph

As the changes of material strength is color separated, there is 5 slope can be identify.
It can be assumed that the material formed by 5 layer of different coated material.

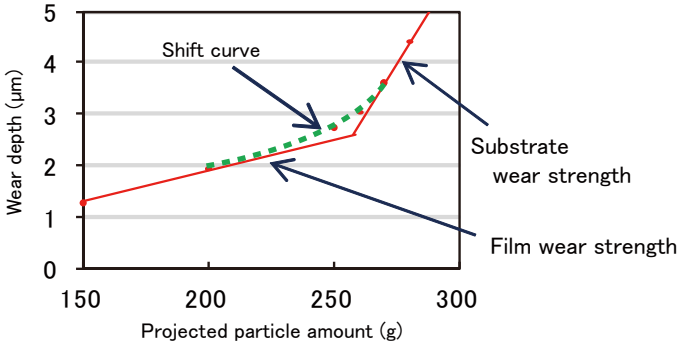
4 Interface layer strength

With the detail plot focusing at interface layer, the change of strength can be visualized as smooth curve.

View point from the graph

Large view of Part② from DLC coated cutting tool measurement result

While using the collaboration of elemental analysis measurement equipment at this curve part, further detail of this interfaces function can be visualize.



Large view of Part② from DLC coated cutting tool measurement result

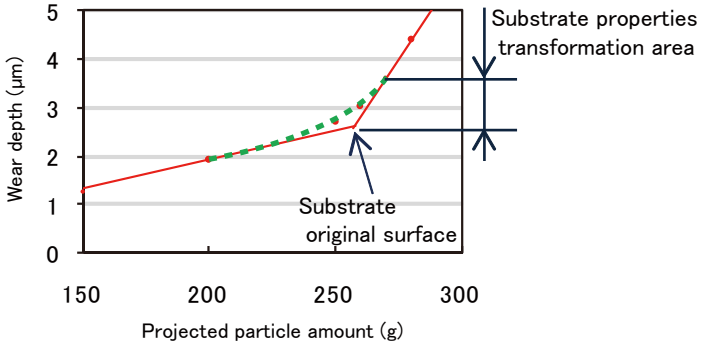
5 Change of properties (substrate)

There is a change of substrate properties possibility according to coating process (change of temperature, spattering, ion dope). This change can be indentified as wear strength.

View point from the graph

The film thickness at the slope intersection is 2.5μm, it can be estimated that the substrate surface existed at 2.5μm thickness. The curve that shown substrate original surface is at curve intersection at 3.5μm depth.

At this point, it can be assumed that at 2.5μm～3.5μm, material strength change according to some changes at the deposition process.



Large view of Part② from DLC cted cutting tool measurement result

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