RHESCA

Patent Number 1704264, 3586112
JIS R-3255 Compatible

CSR-2000 NANO-LAYER SCRATCH TESTER

Available in

1. Deciding film formation conditions
2. Confirming film formation state
3. Measuring adhesive strength of curved thin films.

Target samples include DLC, TiN, ITO, metal films, oxide films, organic films, and resin films.

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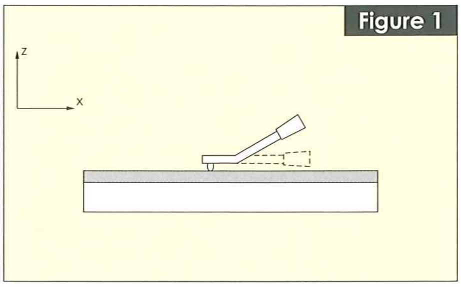
Measurement Principle

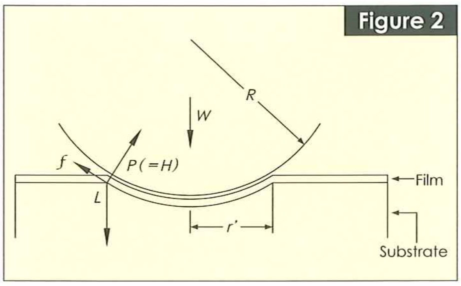
Film surface is scratched in the X direction by a vibrating diamond stylus of a given curvature radius mounted on an elastic arm while the stylus is being lowered in the Z direction (load-increasing direction). The elastic arm is deformed because of the lowering movement of the stylus, resulting in the increased load to the film applied by the stylus **(Figure 1)**.



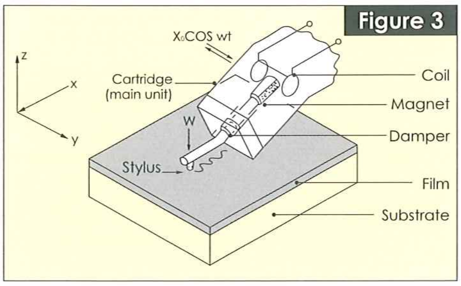
Here, the load applied by the stylus to the film (W) and the shear stress on the boundary surface of the film (f), have the following relationship **(Figure 2)**:

$F=H/\sqrt{(\pi R^2H/W)-1}$ (Equation derived by Benjamin and Weaver),

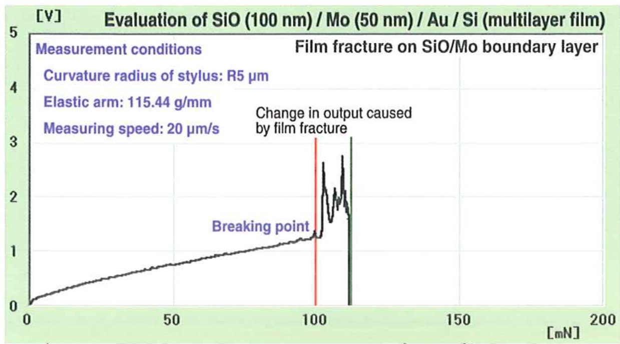
where R is the curvature radius of the stylus, and H, Brinell hardness of substrate. As the load to the film (W) is increased, the shear stress on the boundary surface (f) increases. The film breaks away when the shear stress exceeds the adhesive strength of the film.

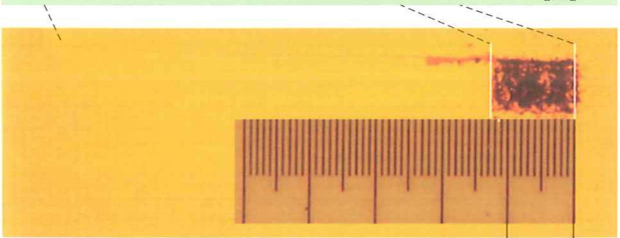


This instrument uses the following procedure to detect film fracture **(Figure 3)**.
A stylus, which is mounted on a cartridge vibrating in the Y direction, is pressed against a film. Then the friction generated between the stylus and the film causes the stylus to lag slightly behind the motion of the cartridge, and the relative position is changed between the magnet mounted on the elastic arm and the coil installed in the cartridge. Thus, electrical output is produced from the cartridge. When the film fracture occurs, the electrical output will change due to the fluctuation of friction coefficient or patterned indented surface. This change in electrical output is used to detect the film fracture, and the critical load at the time of fracture is calculated. (The load value at the time of fracture refers to the critical fracture load.)



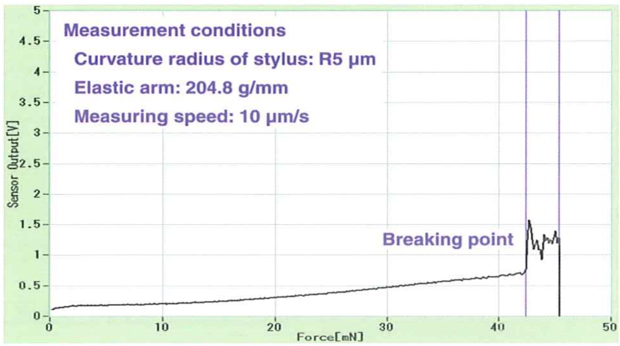
Measurement Example



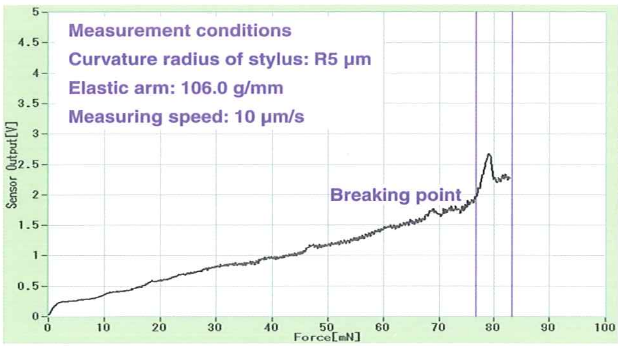


Scratch trace

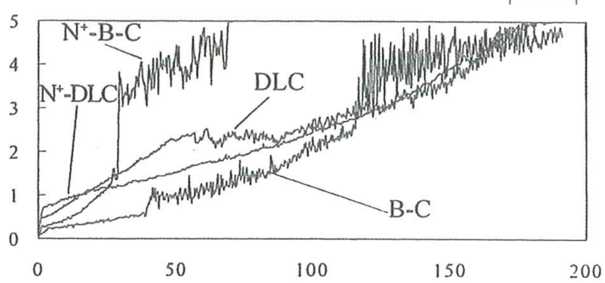
100μm



ITO film



Protective film for a recording disk

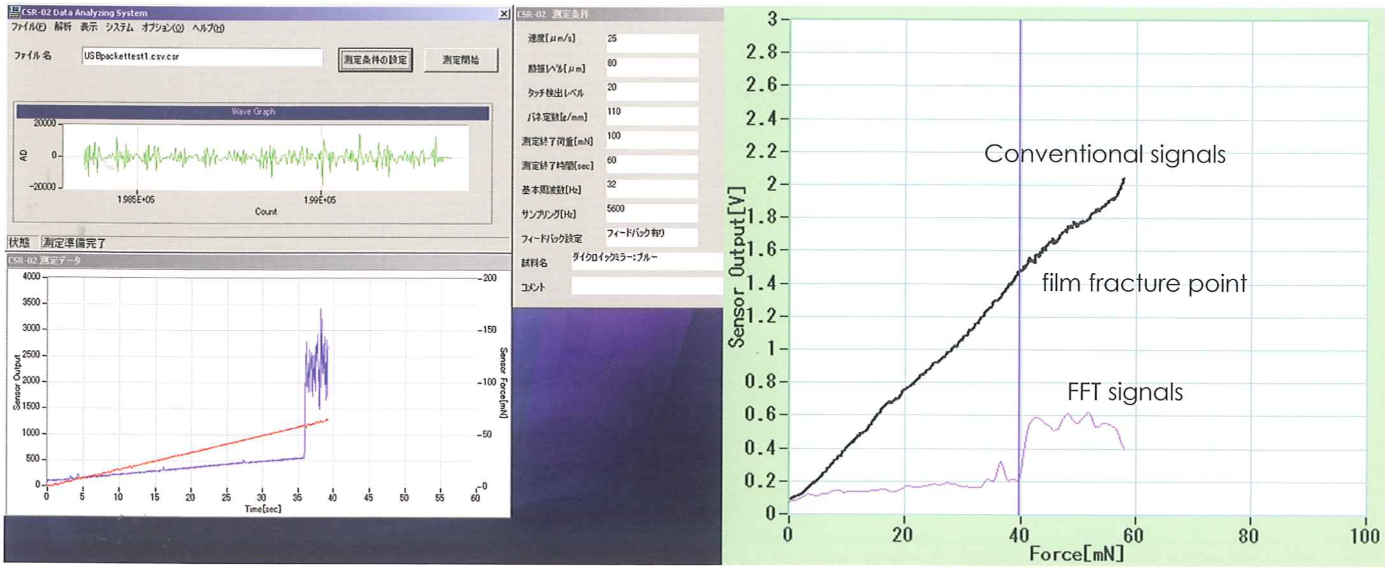


Measurement conditions
Curvature radius of stylus: R15 μm
Loading speed: 90 mN/min

Reference : Shoujirou Miyake (Nihon Institute of Technology), "Effects of Ion Implantation on the Scratch Characteristics of Diamond-like Carbon and Boron Carbide films," Tribologist, Vol. 45, No. 6

FFT Analysis

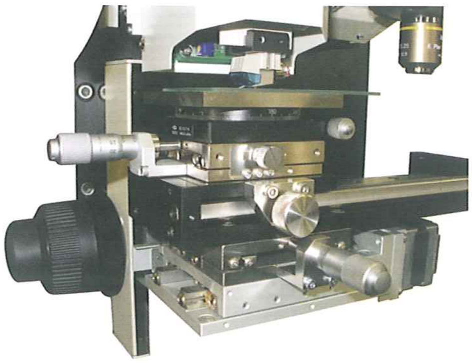
You can transform the signals using FFT based method after take the conventional signals from the stylus cartridge.



Fourier analysis is applied to clearly show changes in fracture-related stylus movement on the graph.

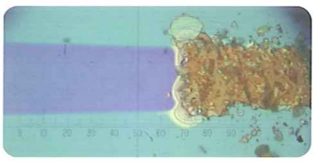
Stage

Enables fine adjustment of X,Y, and θ axes.
Enables the measurement on micro-patterns, if combined with the real-time observation system.



Footprint observation system

Used to moves your measuring target and its holder to the micro-scopic field after measurement.
Use to facilitate observation of scratch traces and comparison with measured data.
Enables the operator to use the microscope for sample positioning.



example of observation

Specifications

CSR-2000		
Load detection section	stress range	1 mN – 1 N
	resolution	0.2 mN (0.02% full-scale)
	allowable overload	300% fullscale
Friction force detection section	velocity signal output	1 mV (1 kHz)
	frequency range	20 Hz – 10 kHz
Excitation section	excitation frequency	45 Hz
	width of excitation	5, 10, 20, 40, 50, 80, 100 μm
Radius of diamond stylus		5, 15, 25, 50, 100 μm
Z- axis (loading direction) drive	drive system	steppingmotor drive
	moving range	20 mm (manual coarse motion: +30 mm)
	drive resolution	0.5 μm (fine mode: 0.1 μm)
	moving speed during measurement	0.1 – 10 μm/sec
	moving speed during measurement preparation	1 mm/sec
X- axis (scratch direction) drive	drive system	steppingmotor drive
	moving range	± 10 mm
	drive resolution	0.5 μm (fine mode: 0.1 μm)
	moving speed during measurement	0 – 20 μm/s
	moving speed during measurement preparation	1 mm/sec
Data output format		USB
Dimensions and weight		575(W)×435(D)×615(H) mm / 31kg
Power source		100-240VAC/60VA

Footprint observation system	
Magnification of microscope	100, 500

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※ Specifications and appearance may be change without previous notice.

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