New composite probe of Rh and Ni-Mn for high current and fine pitch testing

Kazunori Okada (okada-kazunori@sei.co.jp),
Yoshihiro Hirata, Tsuyoshi Haga, Masao Sakuta

Sumitomo Electric Industries, Ltd.

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SUMITOMO ELECTRIC

Agenda

1. Background : needs for advanced probe
2. Concept of new probe : composite of Ni-Mn, Rh and Cu
3. Process : LIGA process
4. Performance : 1A is capable
5. Conclusion

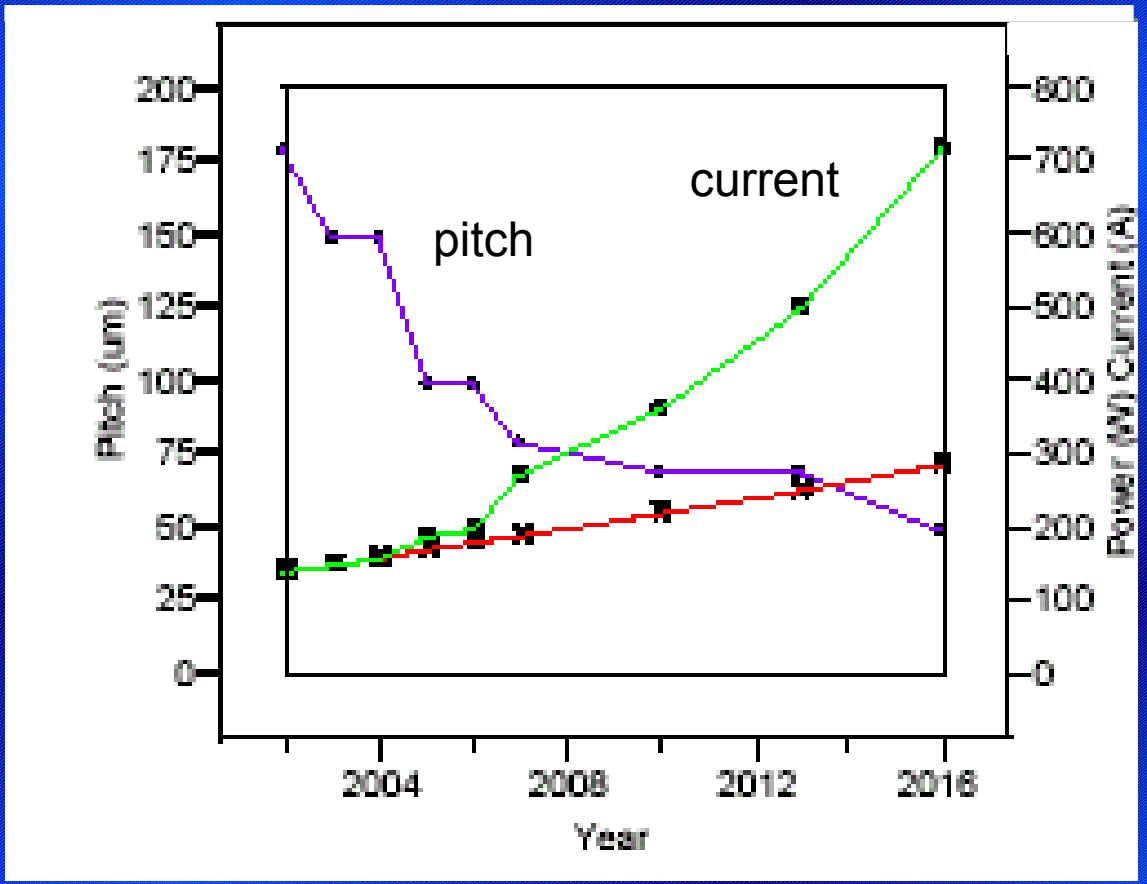
Background (1)

2002 ITRS High Performance Device roadmap

Technical trend of contact probe

(1) Narrow pitch

(2) High current



Background (2)

2002 ITRS High Performance Device roadmap

Technical trend of contact probe

(1) Narrow pitch	GOOD Electroformed nickel	NG Tungsten
(2) High current	NG Electroformed nickel	GOOD Tungsten

New material for advanced probe is required !

Concept of new probe (1)

Concept

(1) Process : Lithography & Electroforming for narrow pitch

(2) Material : composite

< Electroformable metal >

	mechanical property	conductivity	contact resistance
Ni-Mn	＋＋	＋	＋
Rh	―	＋＋	＋＋
Cu	―	＋＋＋	―
?	＋＋	＋＋	＋＋

GOOD composite

Single material

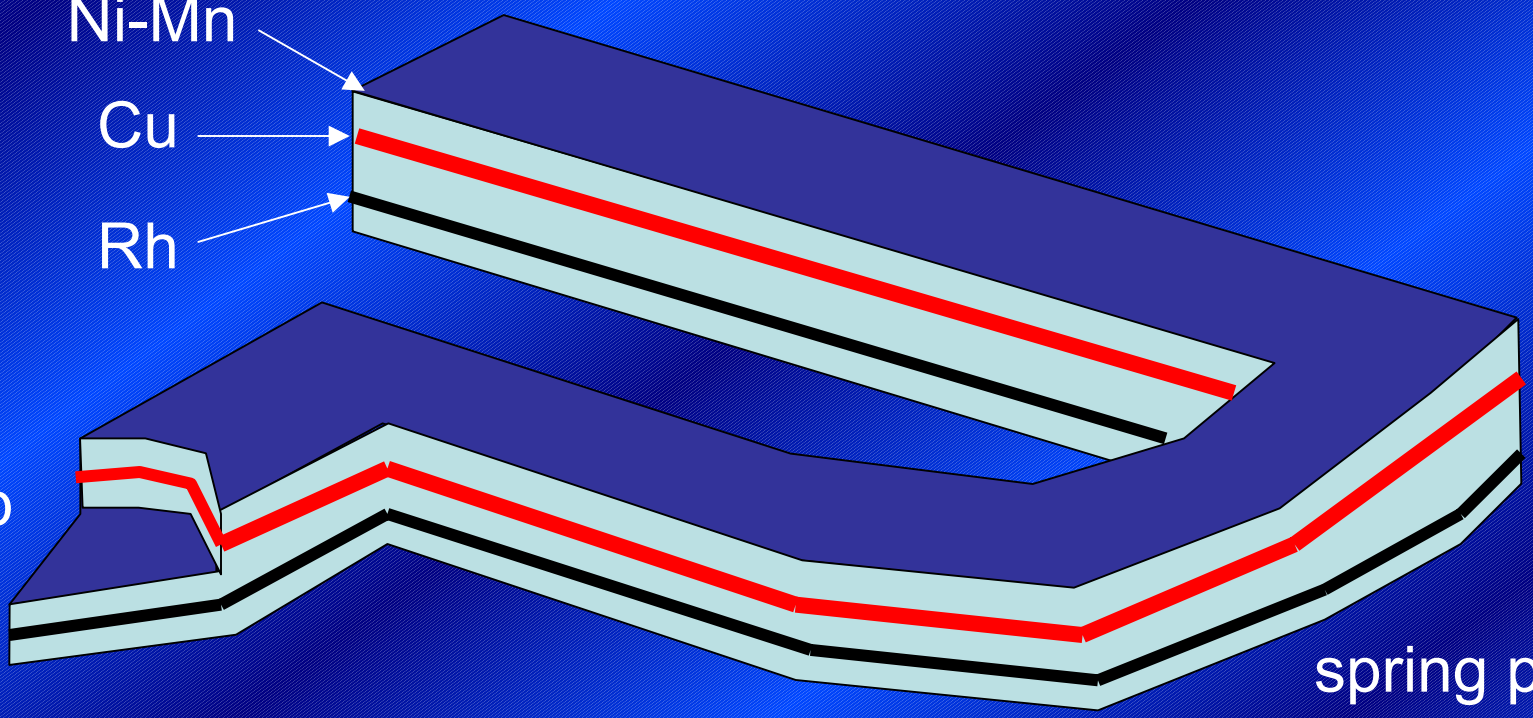
No Existence

Concept of new probe (2)

Ni-Mn : good mechanical property

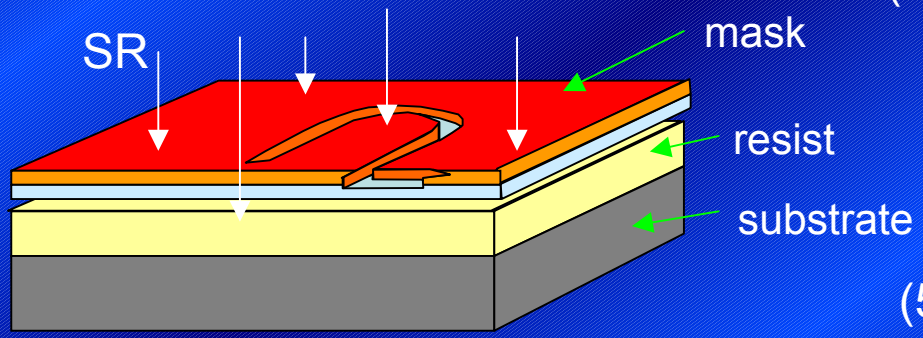
Cu : good conductivity(current & heat)

Rh : low Cres & good conductivity

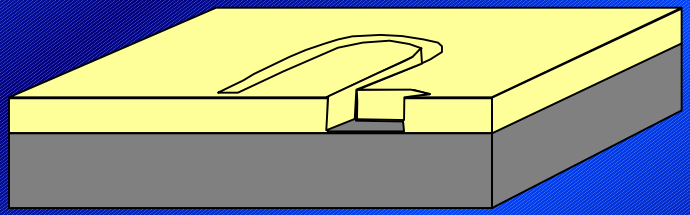


Process (1)

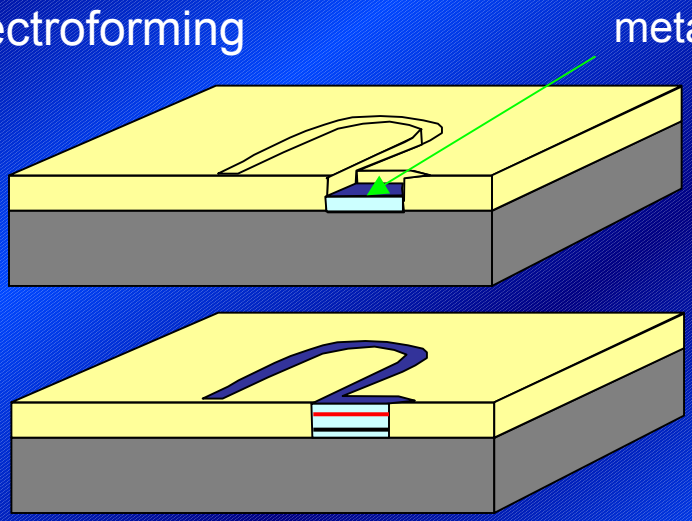
(1) SR (synchrotron radiation) irradiation



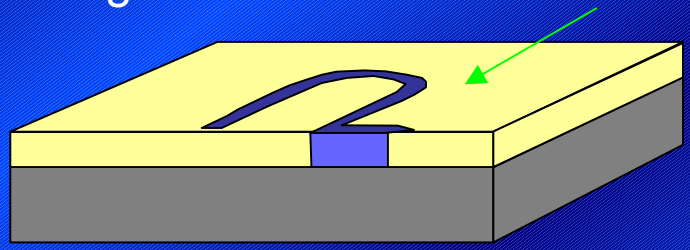
(2) Developing



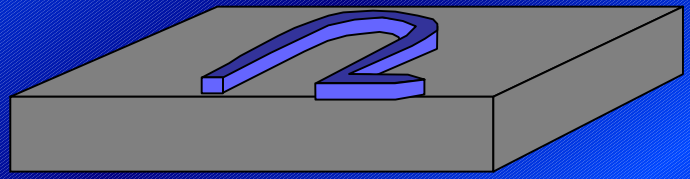
(3) Electroforming



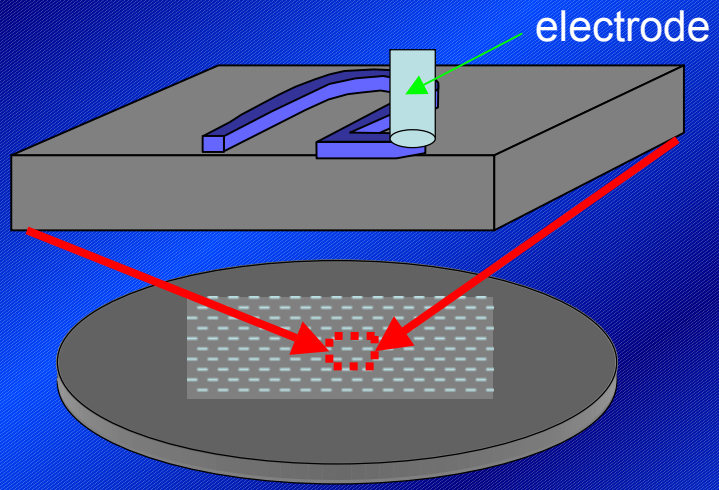
(4) Polishing



(5) Removing resist

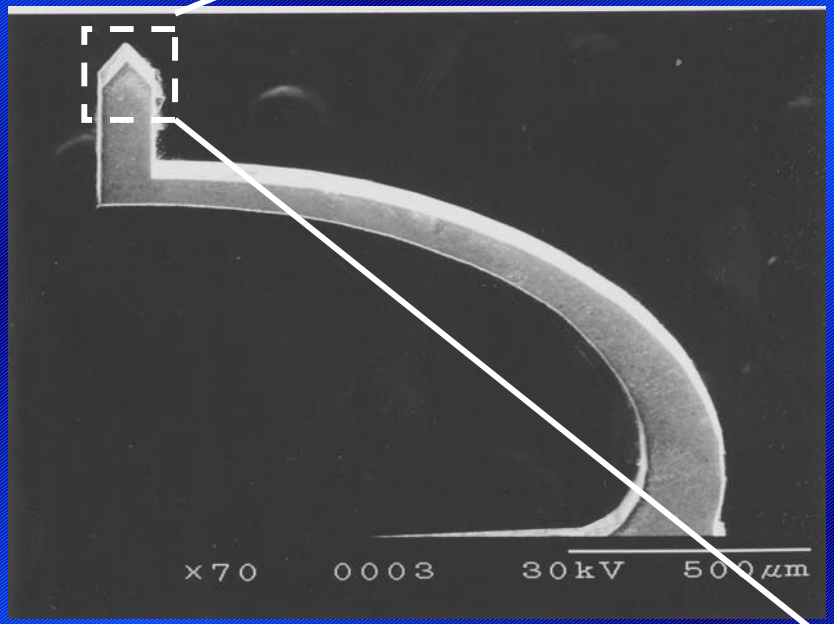


(6) Electro-discharge machining



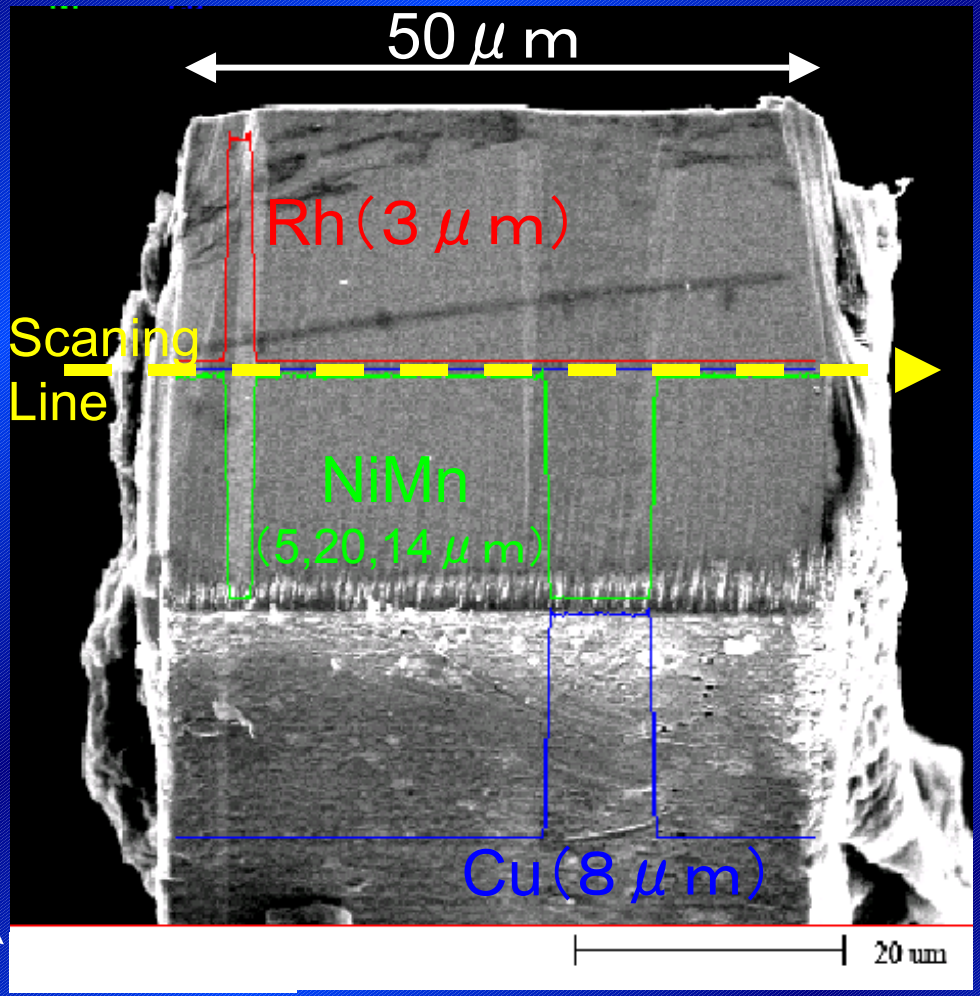
Many parts on the substrate !

Process (2)



Contact probe

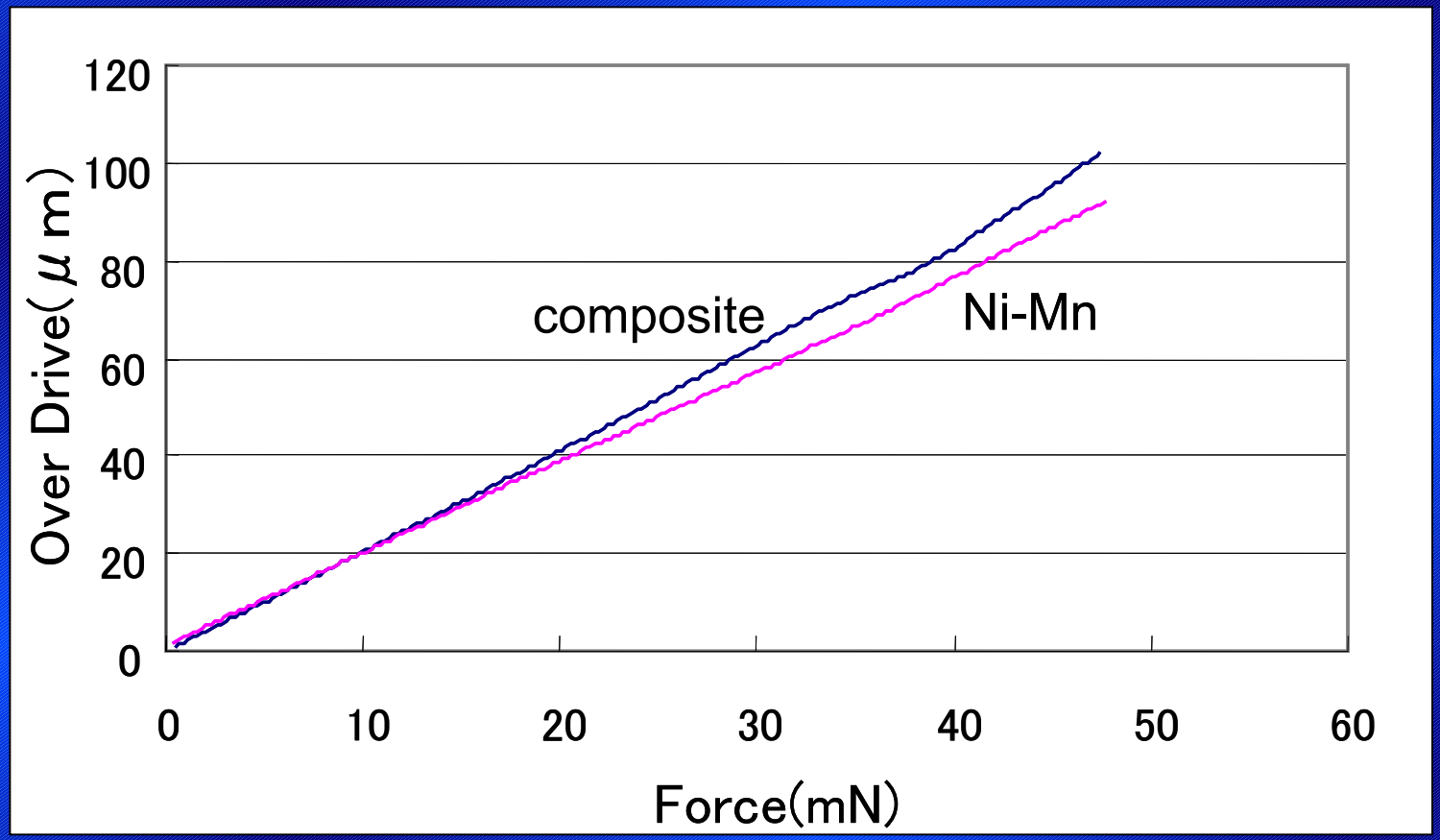
Cross Section



Overall resistance is calculated as 83% of Ni-Mn probe !

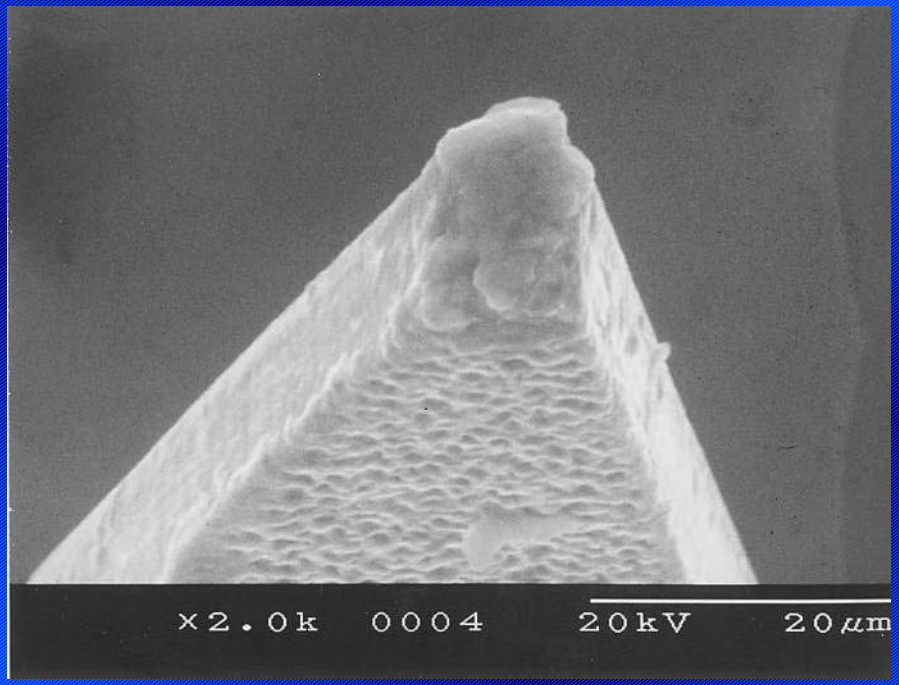
Basic properties (1) mechanical performance

Composite probe's spring constant is 90% of Ni-Mn.

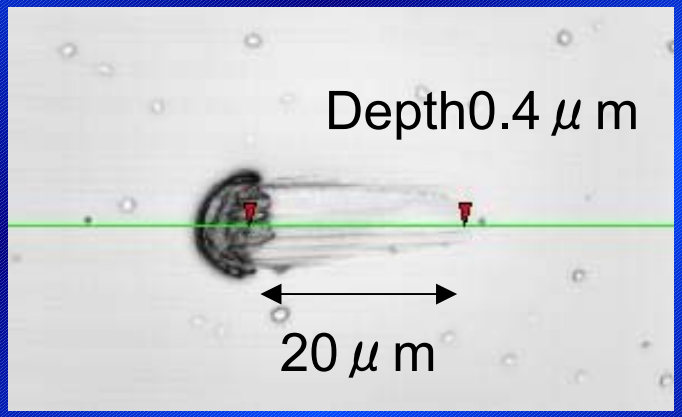


Basic properties (2) touchdown test

1) Scrub mark didn't curve.
2)After 30,000 touch down (@27mN),
  >The tip was not worn out
  >There is no boundary separation.



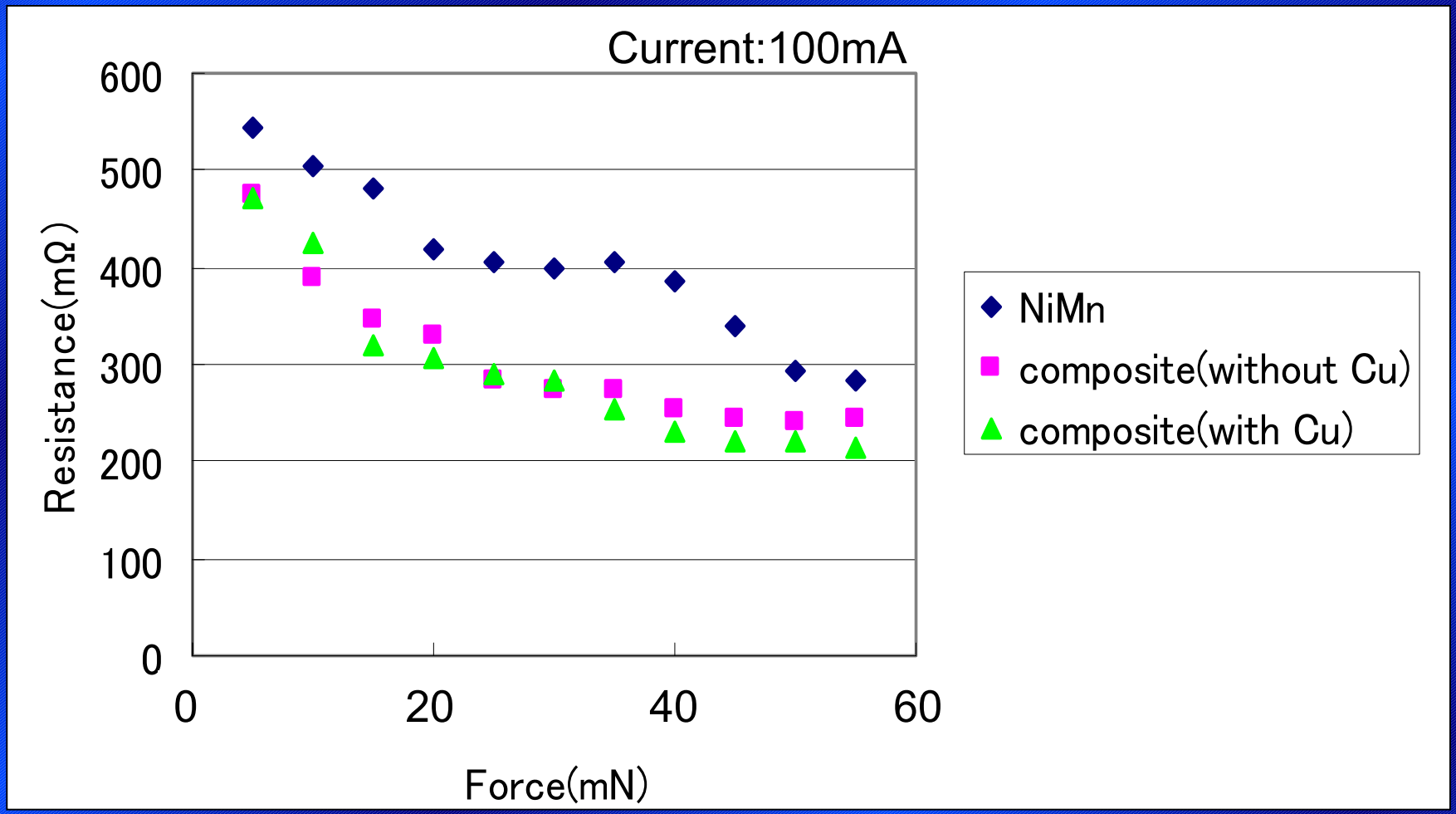
Tip shape after 30,000 TD



Scrub mark

Composite probe is available!

Basic properties (3) overall resistance

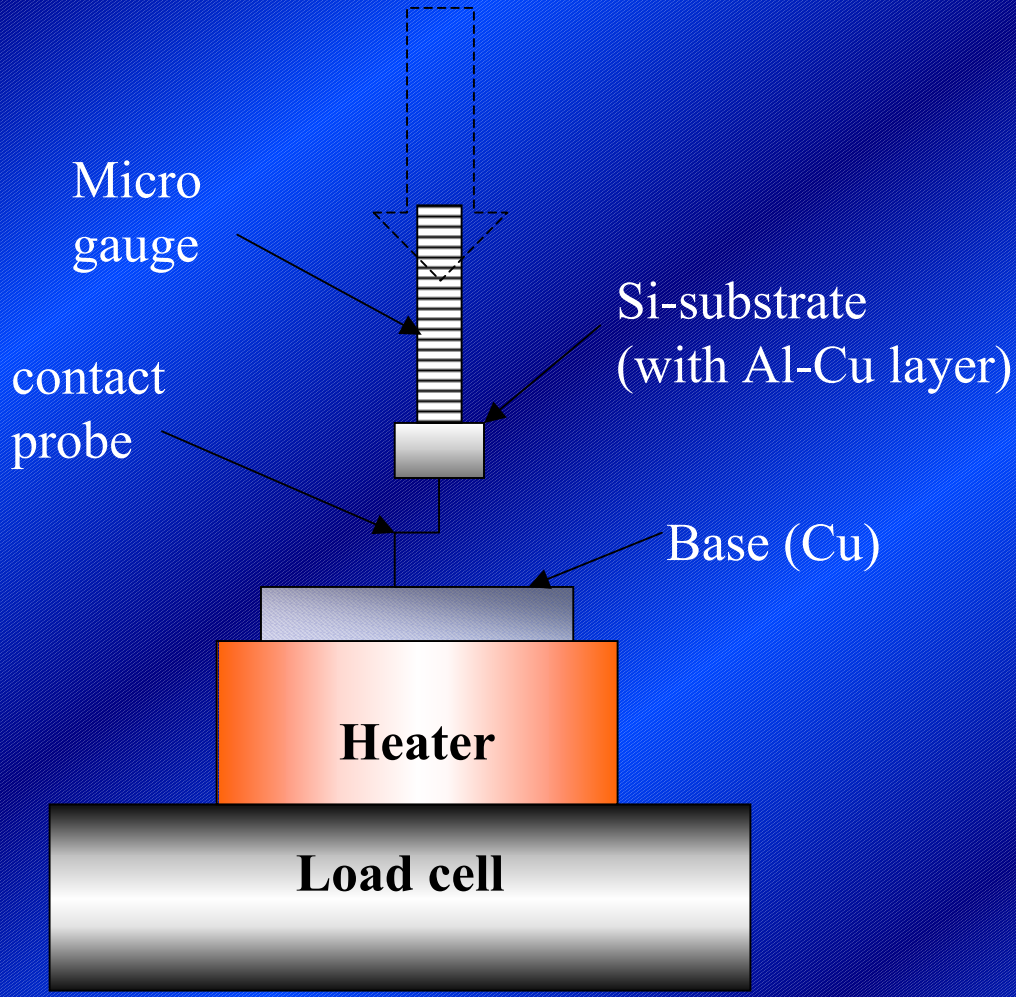


Rh layer decreases contact resistance.
At low current, resistance does not depend on Cu layer.

Current capacity (1) measuring system

Measuring object
- >force
- >overall resistance

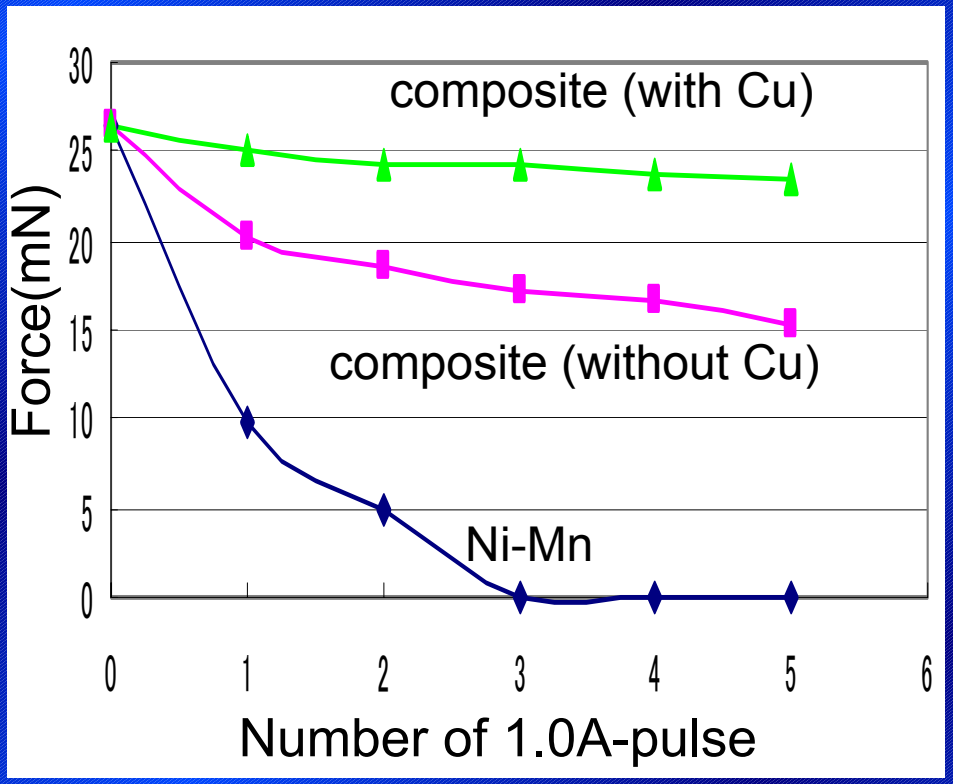
Setting
- >over drive : 0-200 μ m
- >current : 0 – 2A
- >pulse width : 10-1000ms
- >temperature : RT-200℃

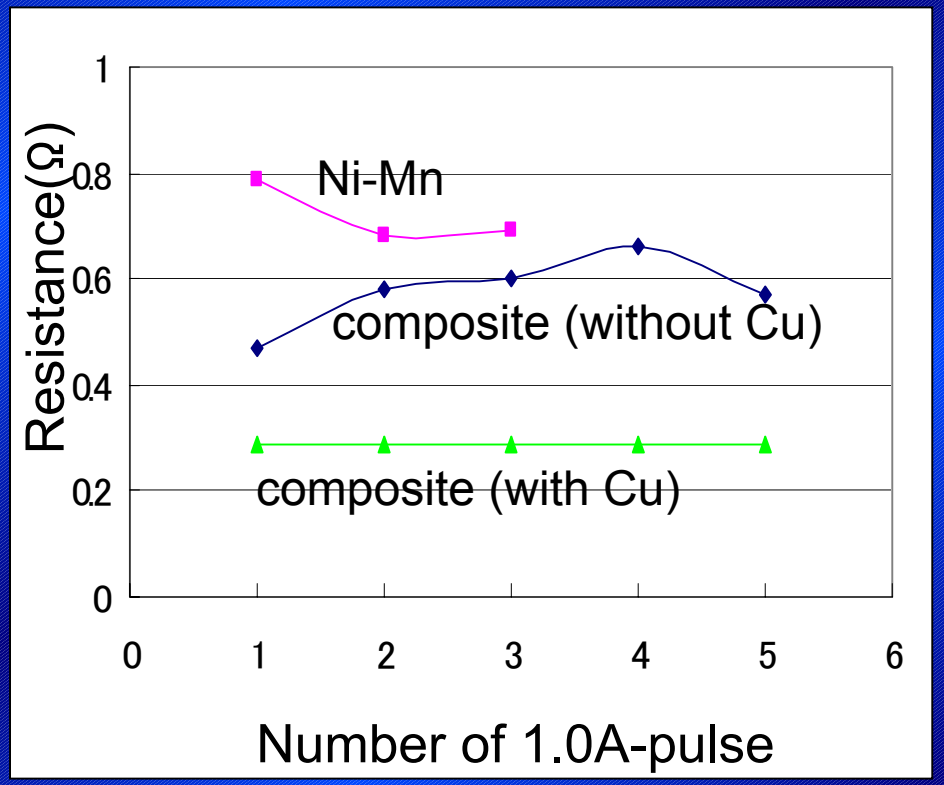


Schematic view of measuring system

Current capacity (2) 1A current carrying test

Test condition
>@room temp. >pulse : 1A x 1s

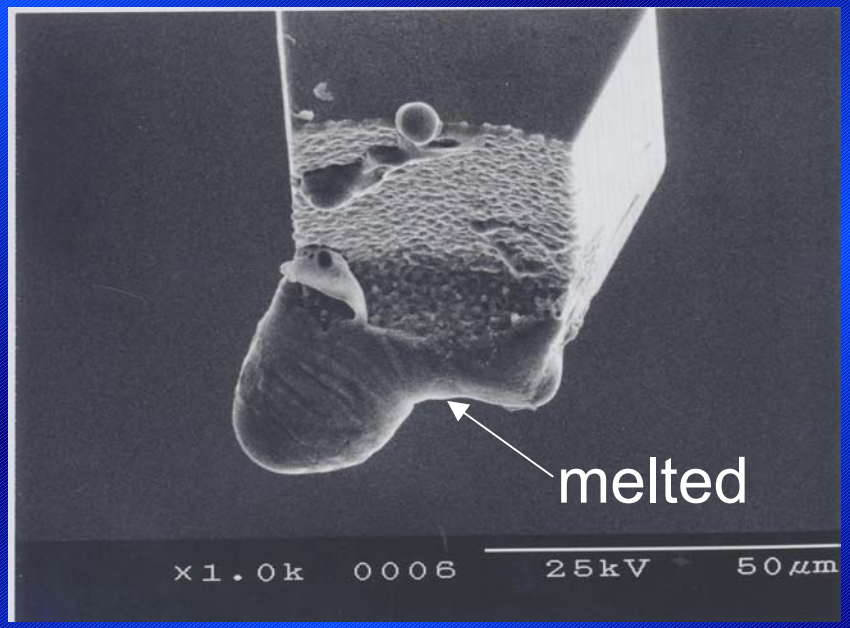




Composite probe can carry 1A @room temp.
Cu layer goes down overall resistance.
It restrains joule heating and helps heat-diffusion.

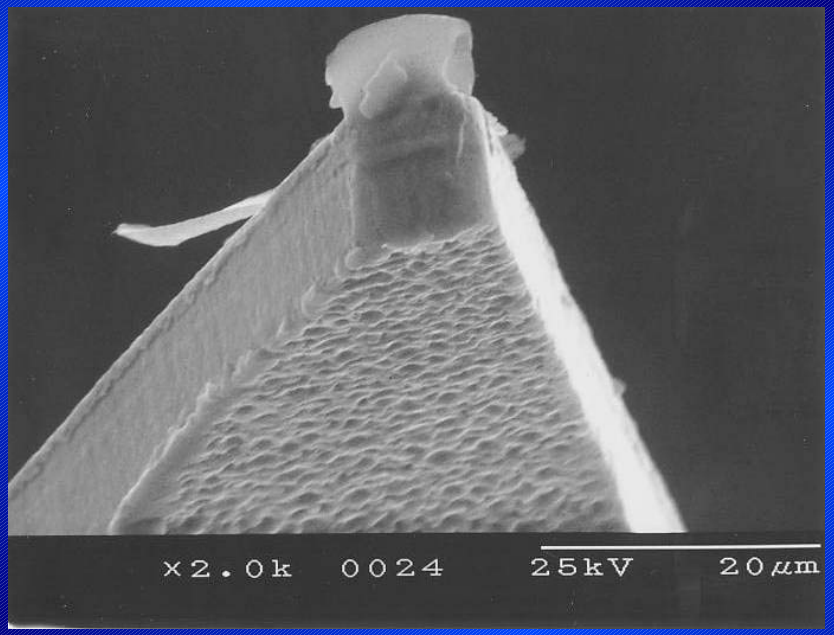
Current capacity (3) After 1A current carrying

Ni-Mn



after 1.0A × 1s

composite

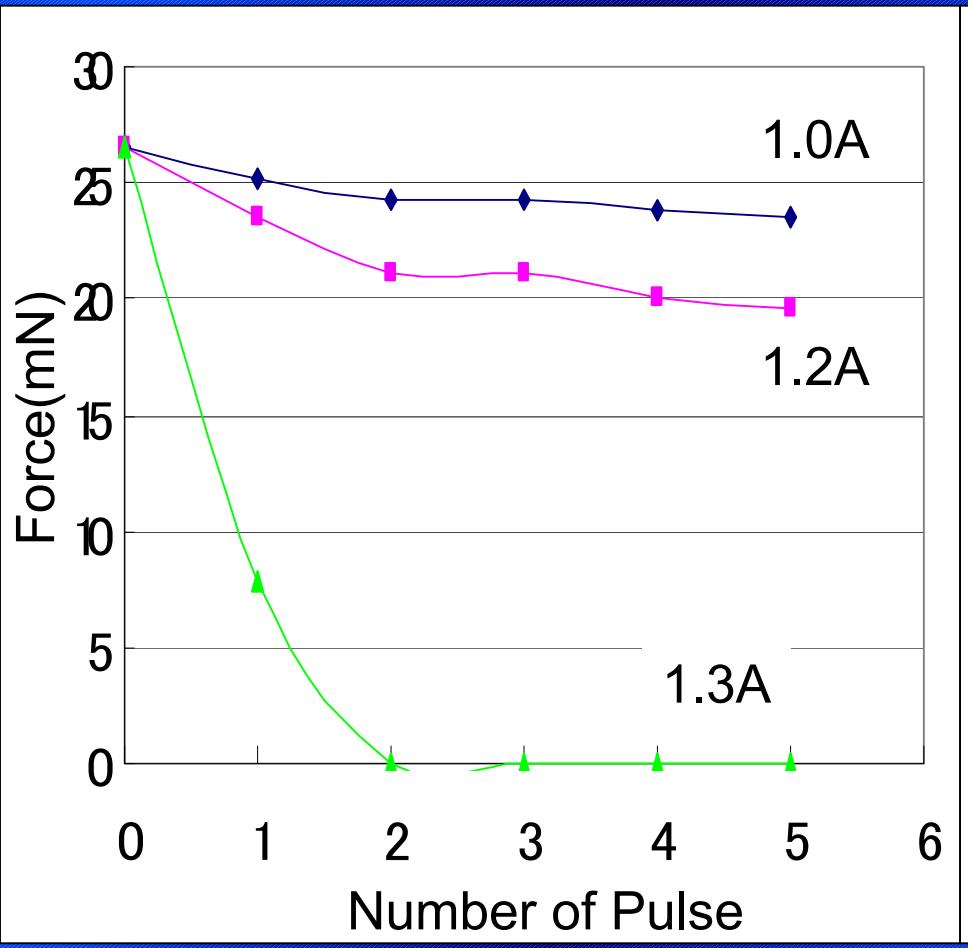


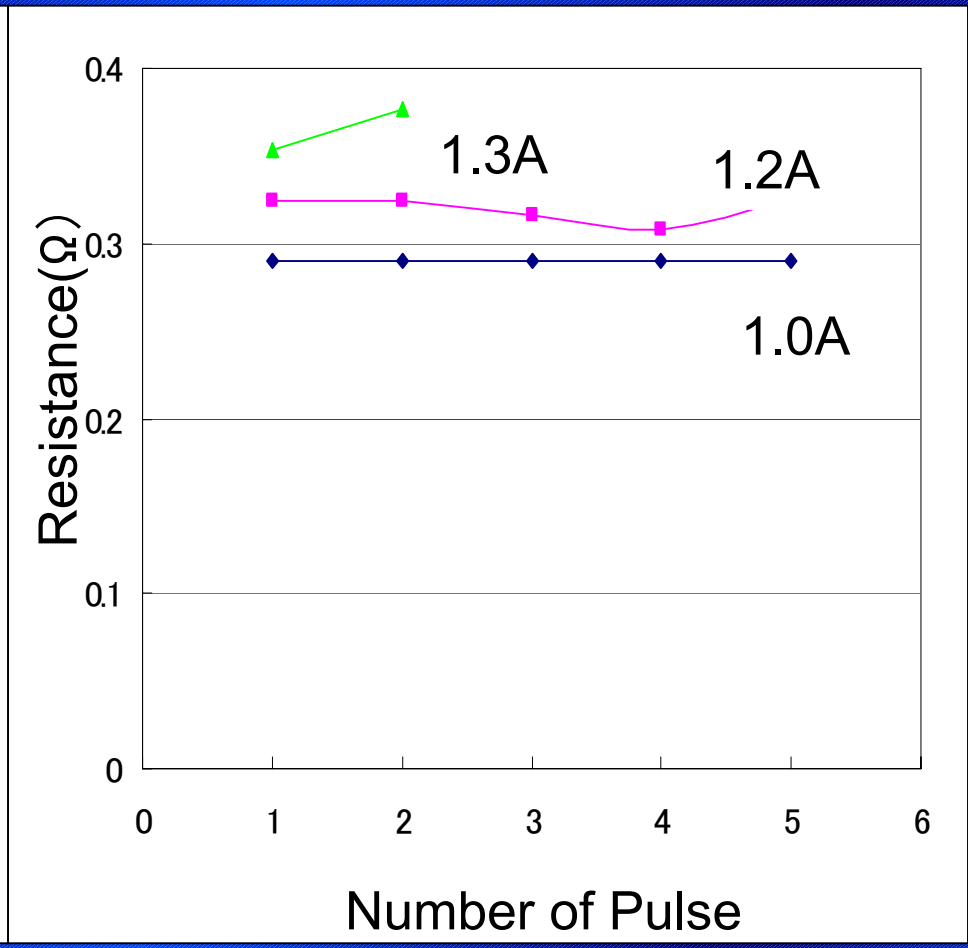
after 1.0A × 300s

Contact resistance goes down by Rh layer.
And the tip avoids melting after 1A × 300s.

Current capacity (4) Limited current

Test condition
>@room temp. >pulse width :1s

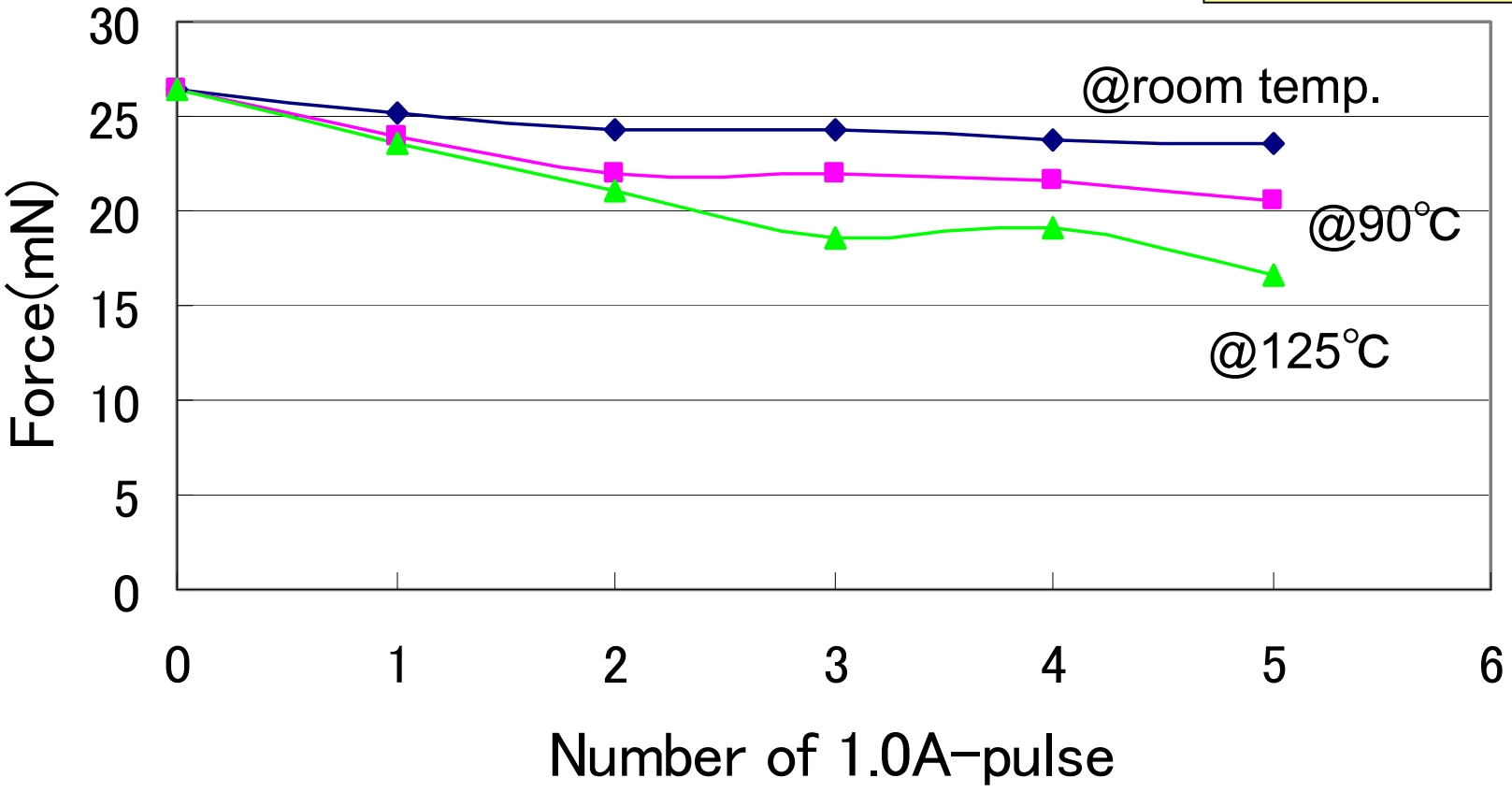




At room temp, upper limit current increases to 1.2A.

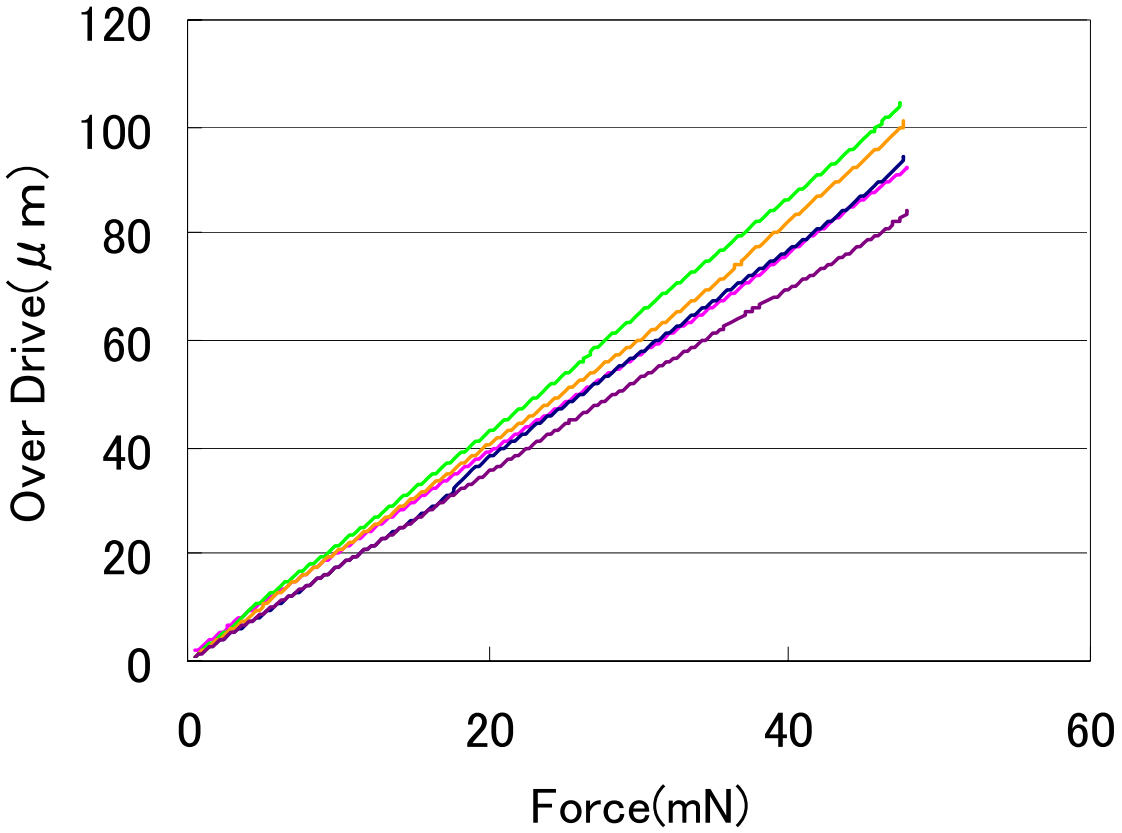
Current capacity (5) temperature effect

Test condition
>pulse : 1A x 1s



Composite probe can carry 1A @90℃.

Transition of probe's spring constant



CP spring constants didn't change after testing.

Conclusion

(1)We proposed composite probe of Ni-Mn and Rh, Cu for high current and fine pitch testing.

(2)We fabricated composite probe by lithography and electro-forming for 80 μm pitch, and confirmed followings;

> There was no boundary separation after 30,000 TD test. Composite probe was available.

> The overall resistance was lower than conventional Ni-Mn probe.

(3)The current capacity was 1.0A @90℃, and 1.2A @RT.

(4) It will be able to improve the current capacity by revising layer thickness, tip shape and/or spring shape.