SW Test Workshop
Semiconductor Wafer Test Workshop

A Novel Measurement Method for Measuring CCC and MAC at once

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Contact Technologies

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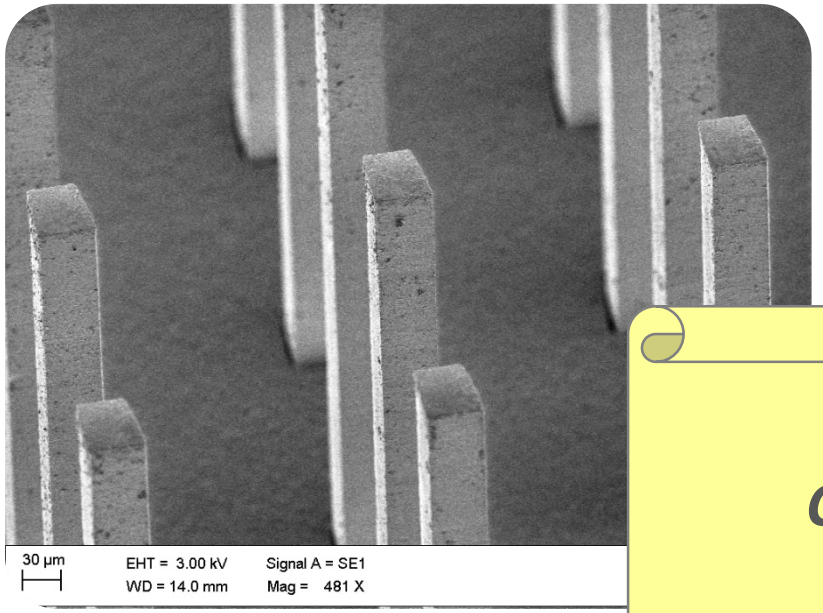
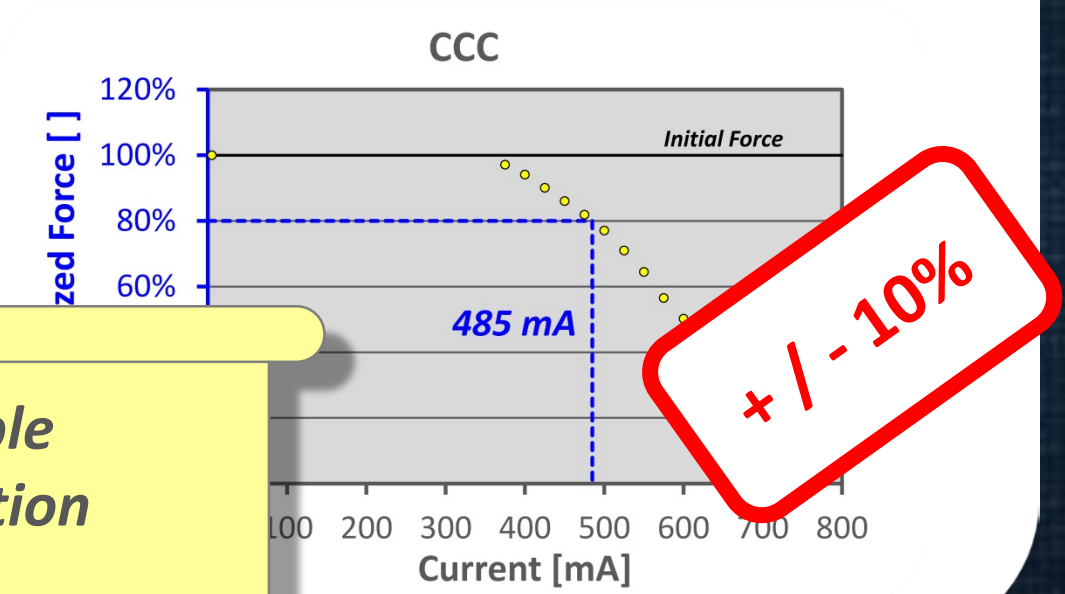
Objectives

New MEMS Product



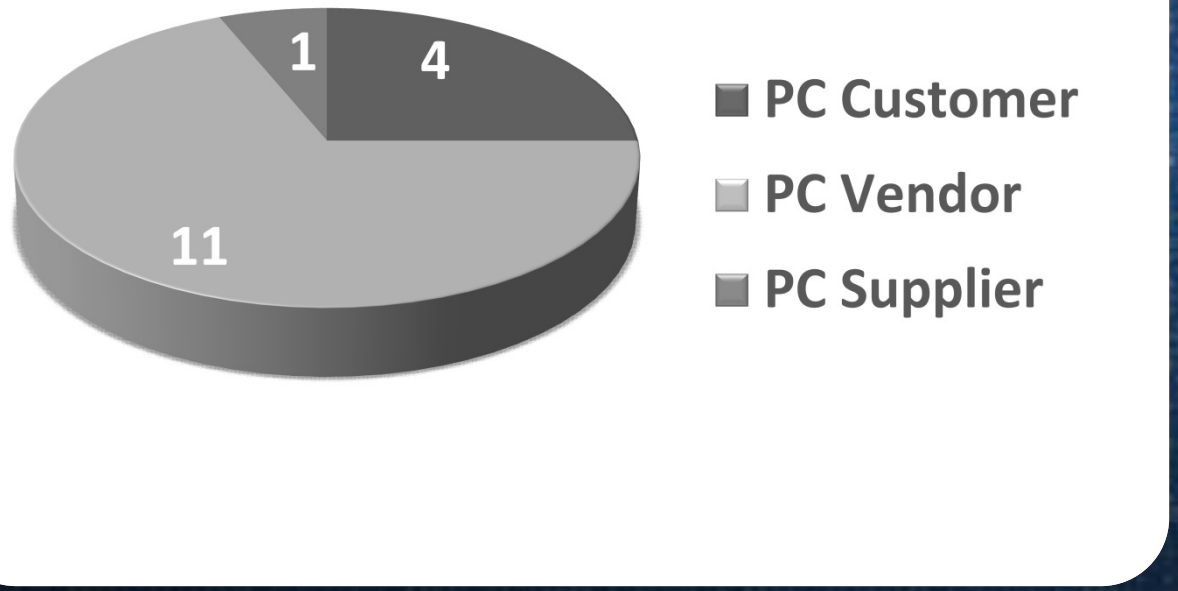
Large Scatter of Measurement Results

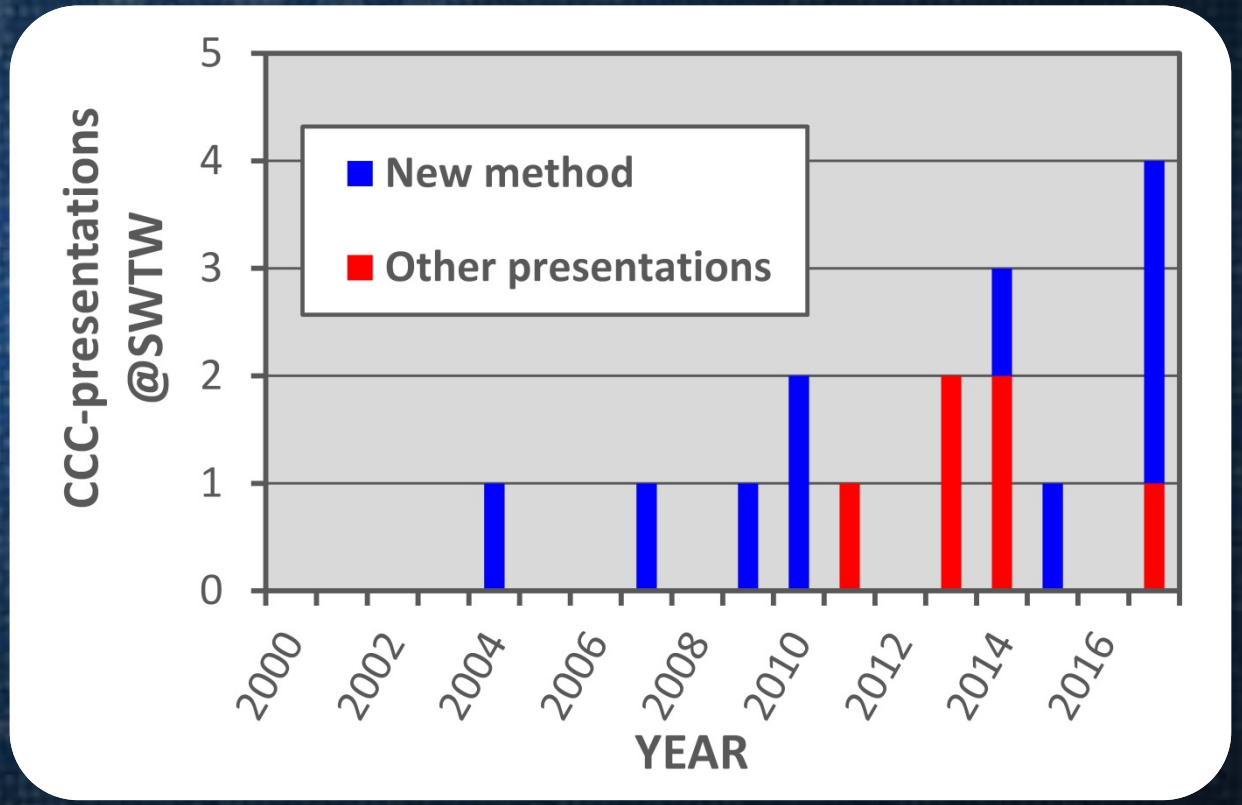


Reproducable Characterization of Current Carrying Capability

Methods

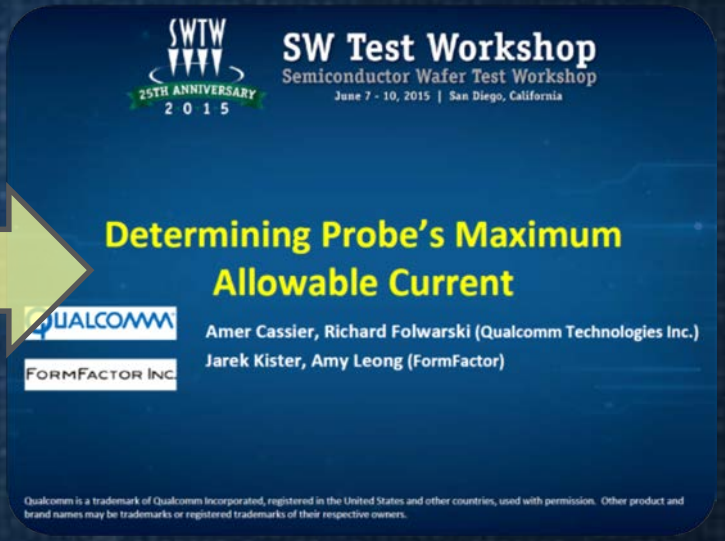
- CCC a Topic Often Presented at the SWTW





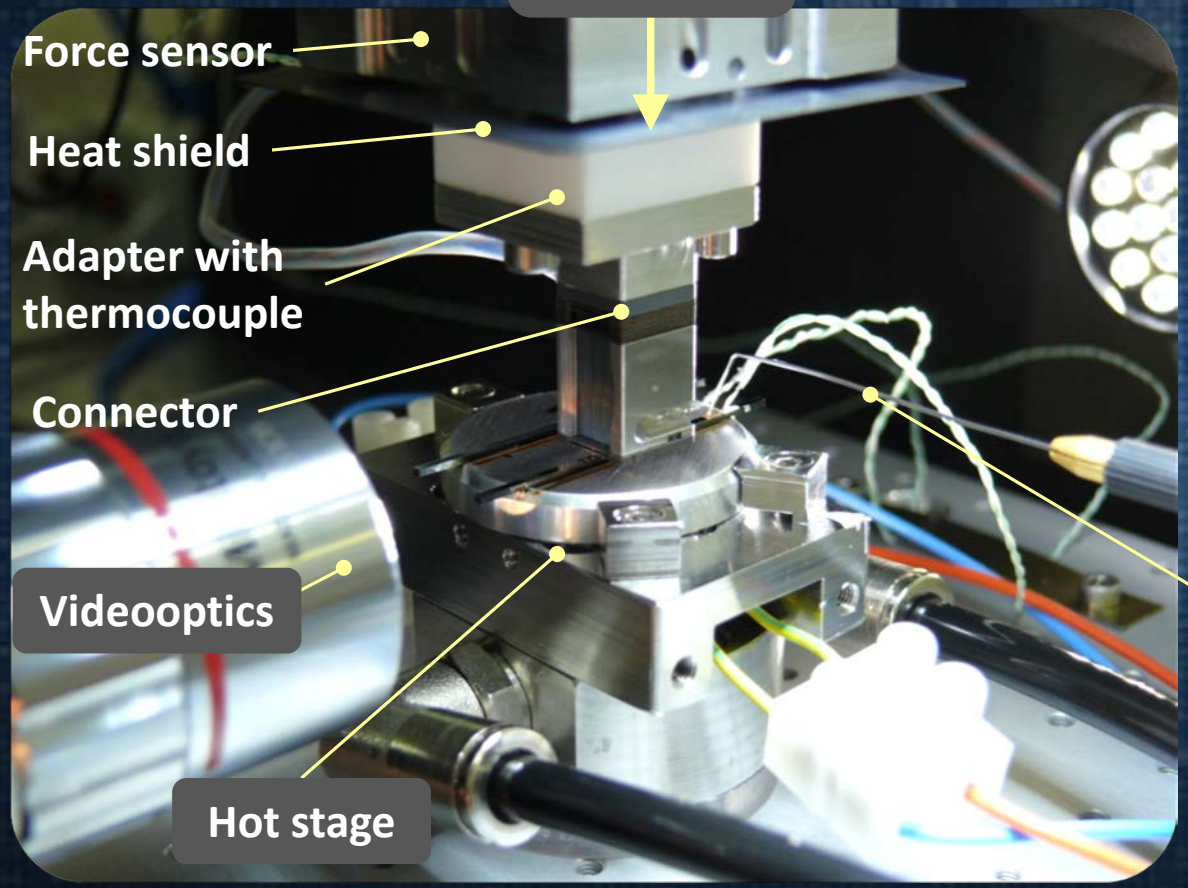
Methods

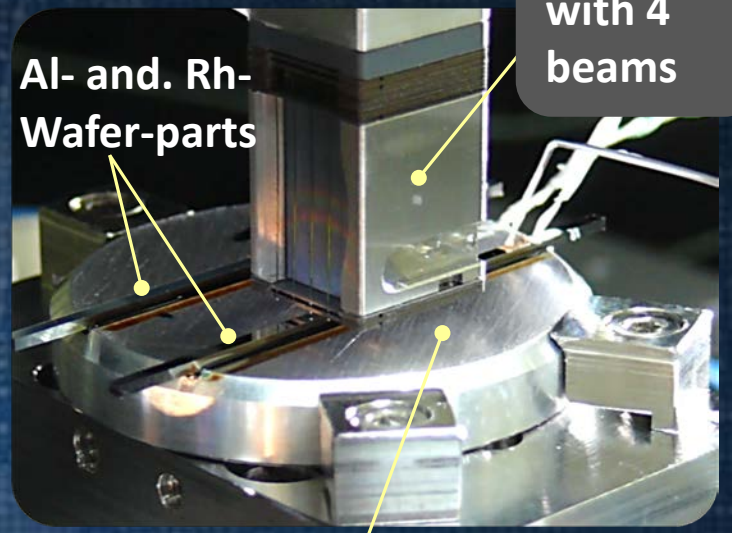
- **Current Carrying Capability – Main Presentations**



Methods

- **Test Setup**



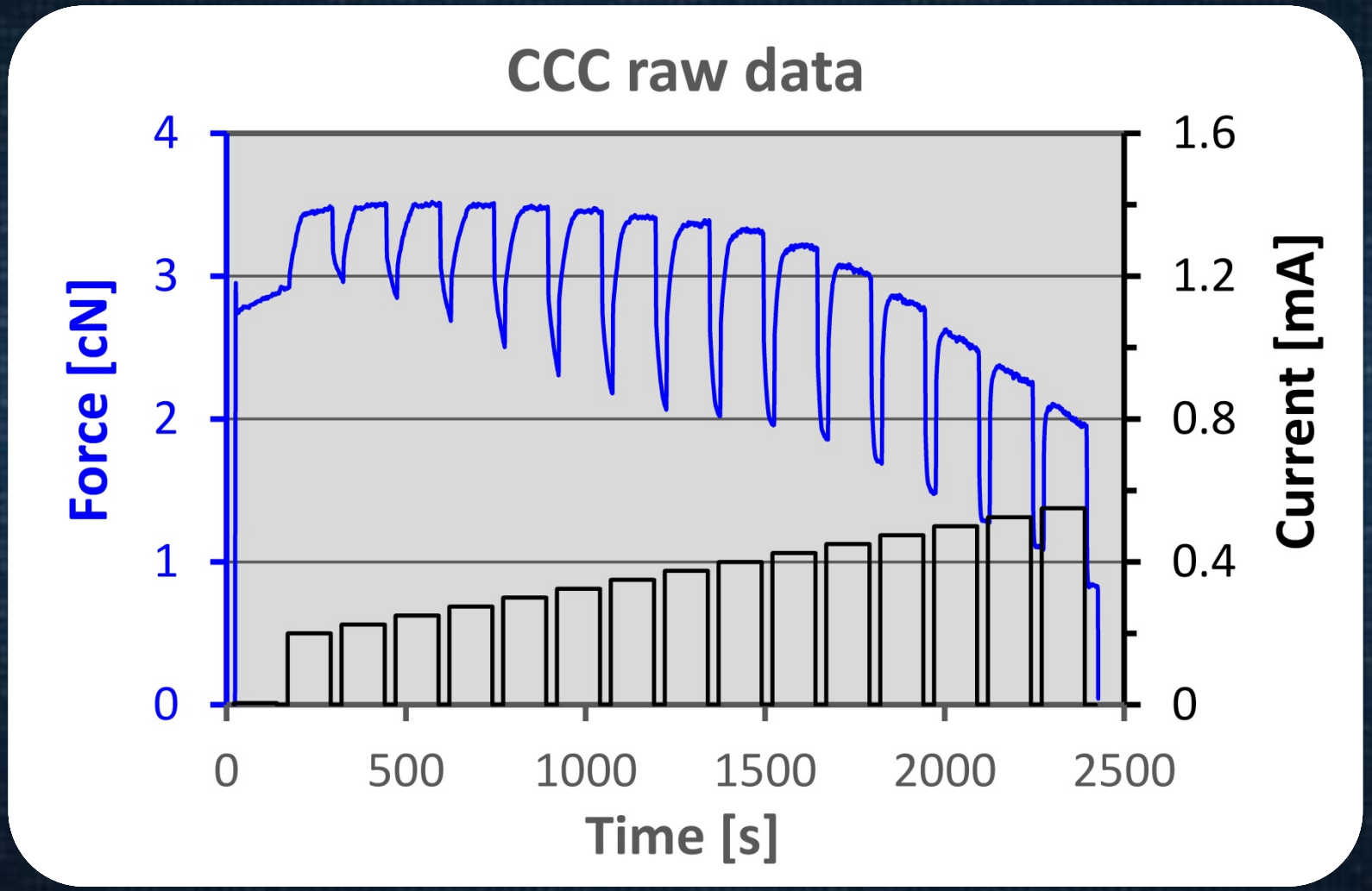


Specimen holder with attached Al- and Rh-Wafer-parts

Contacting (Tungsten needle)

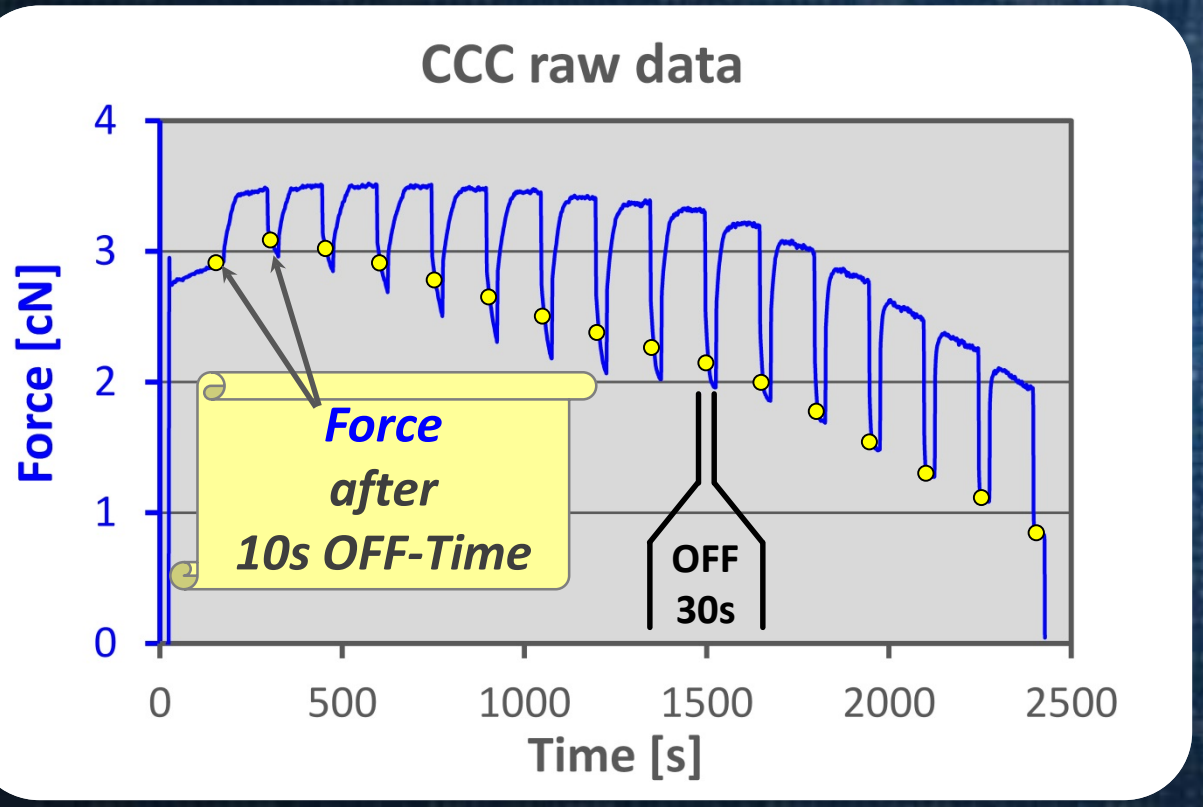
Thermocouple on the wafer surface

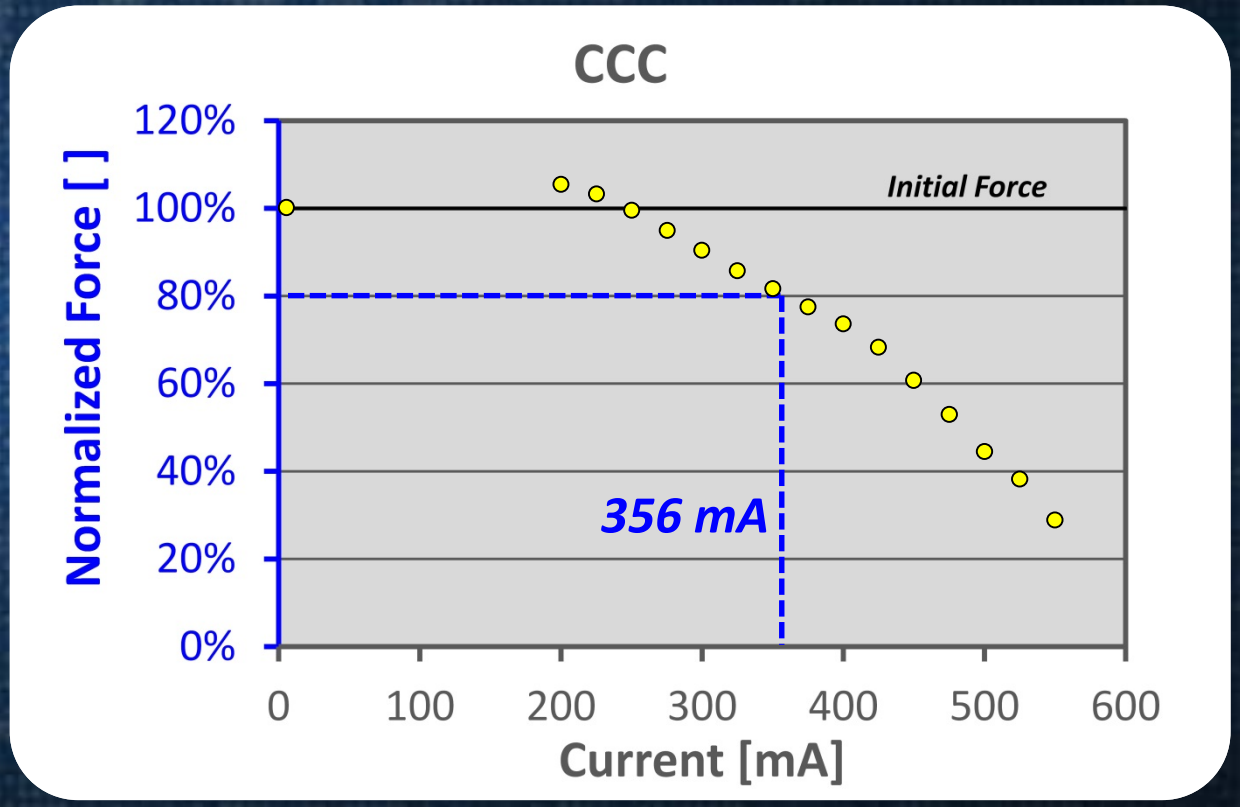
Methods


CCC raw data
Force [cN]
Current [mA]
Time [s]
0
1
2
3
4
0
0.4
0.8
1.2
1.6
0
500
1000
1500
2000
2500

Methods

- Standard CCC (ISMI 2009)





Methods

- **Influence on the CCC Result**

CCC according to ISMI 2009

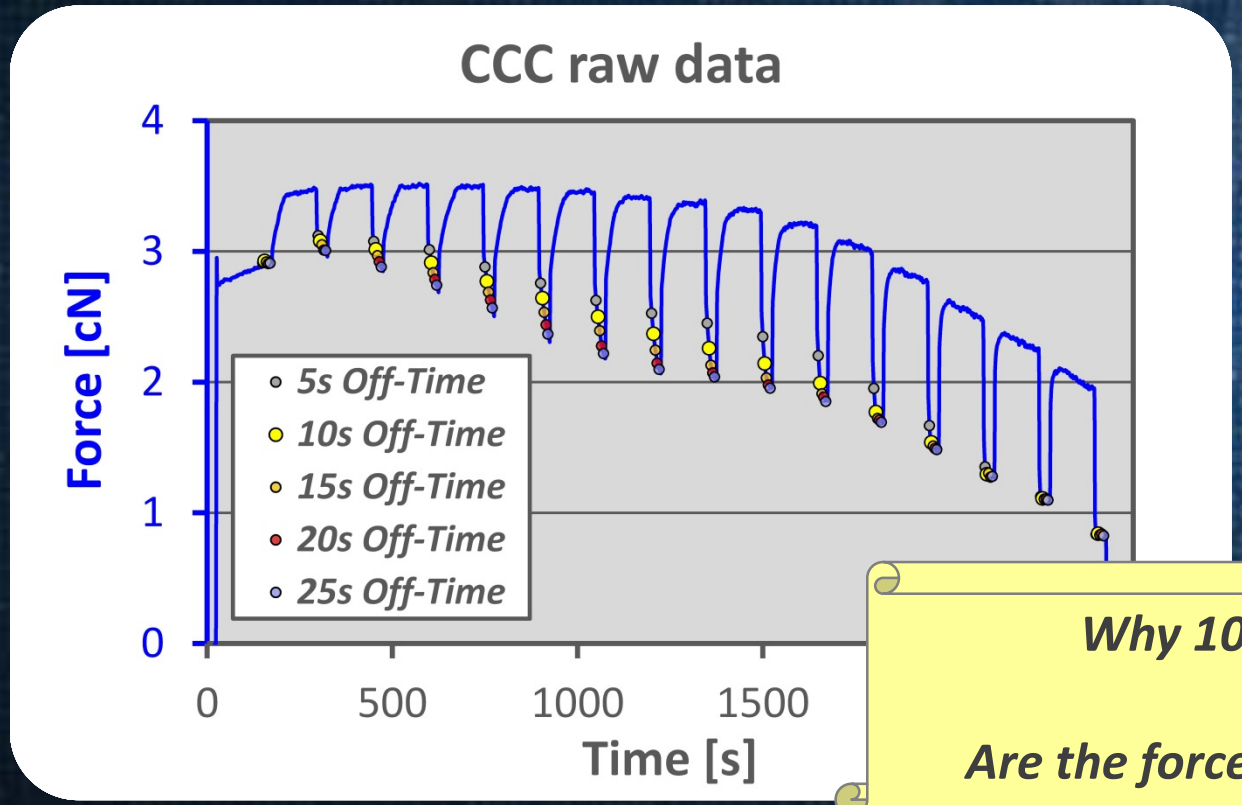
Vertical probe card technology

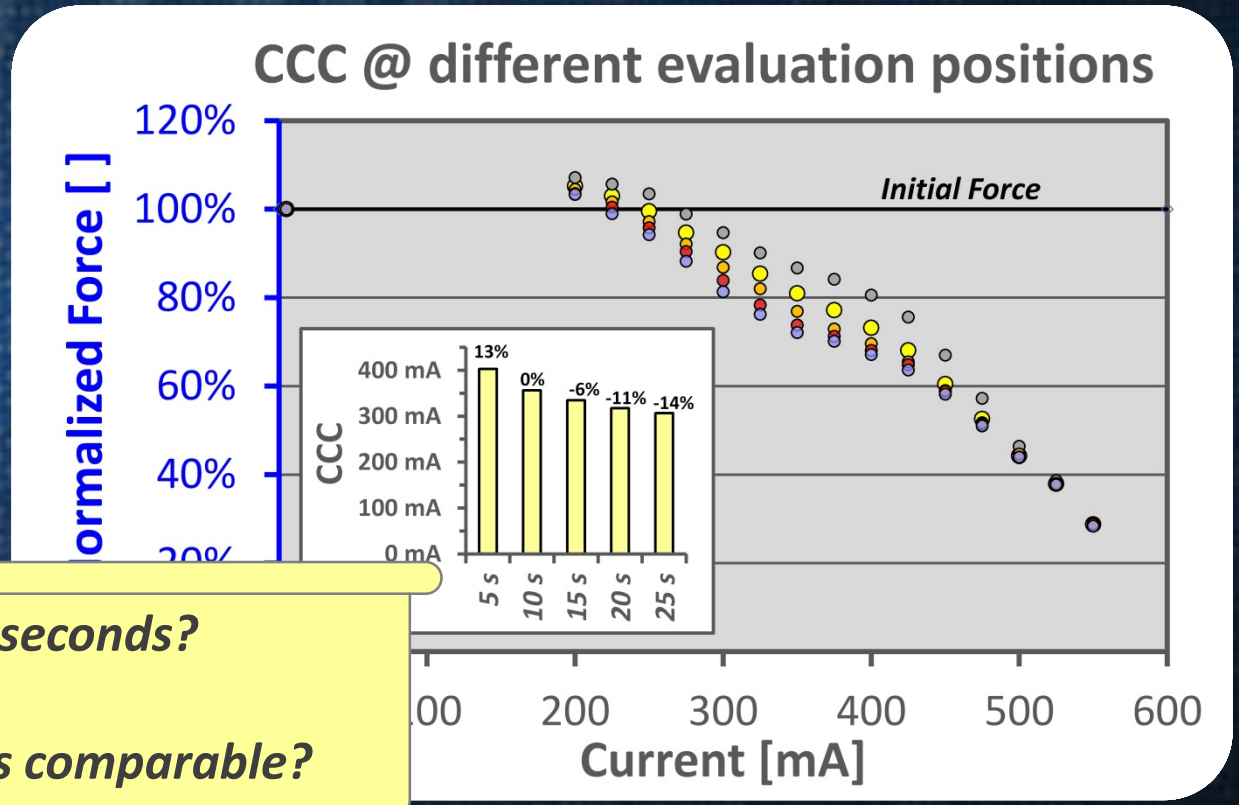
➔ DO WE COMPARE COMPARABLE FORCES?

  - Evaluation position of the force
  - Initial force

Methods

- **Evaluation Position of the Force**





Why 10 seconds?

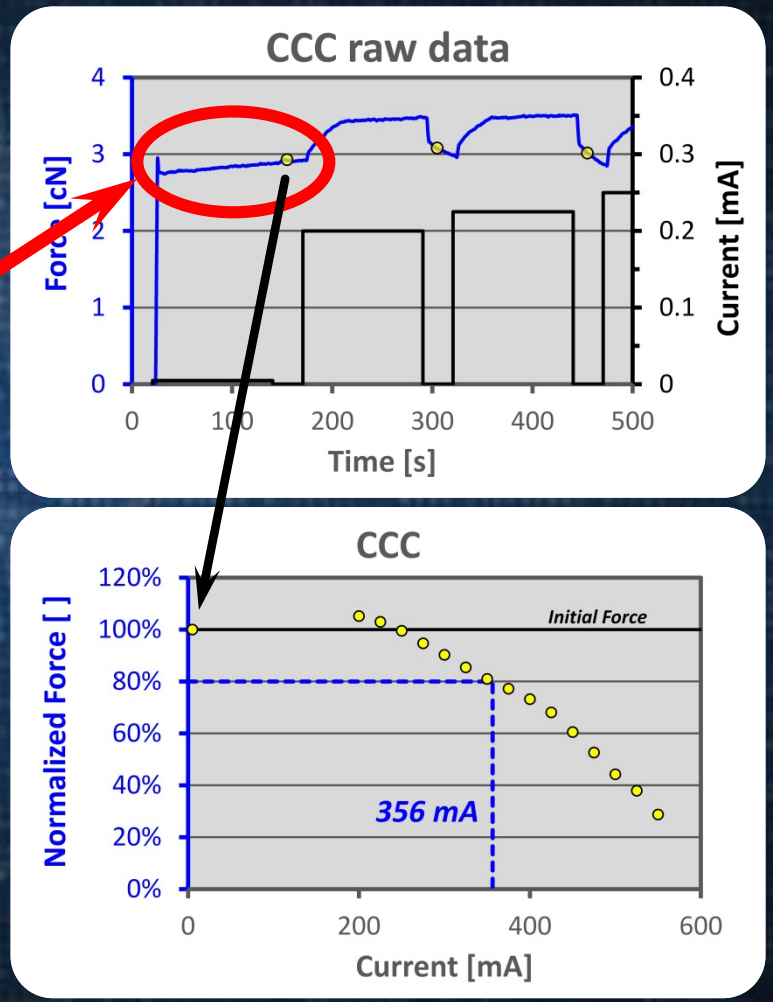
Are the forces comparable?

Methods

- **Initial Force**

The initial force has a large impact on the CCC result!

➔ *IS THE **INITIAL FORCE** WELL DEFINED?*

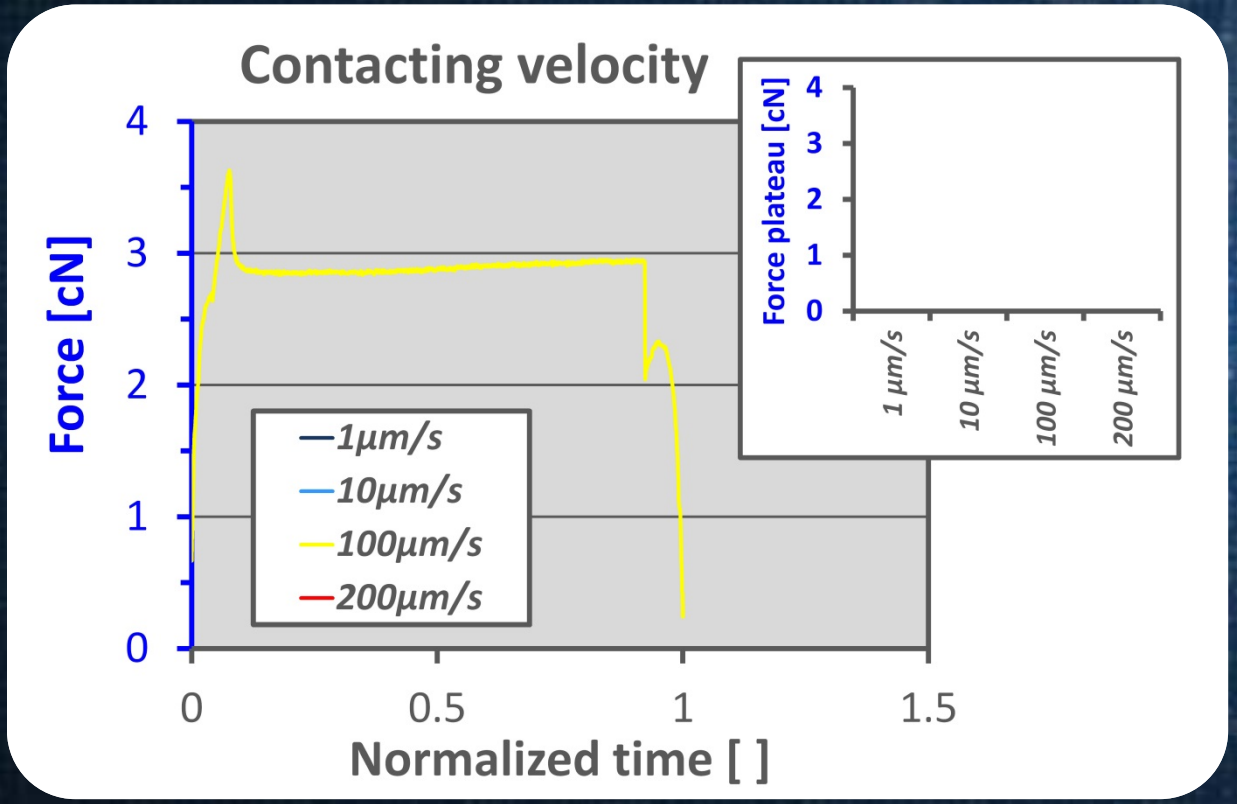


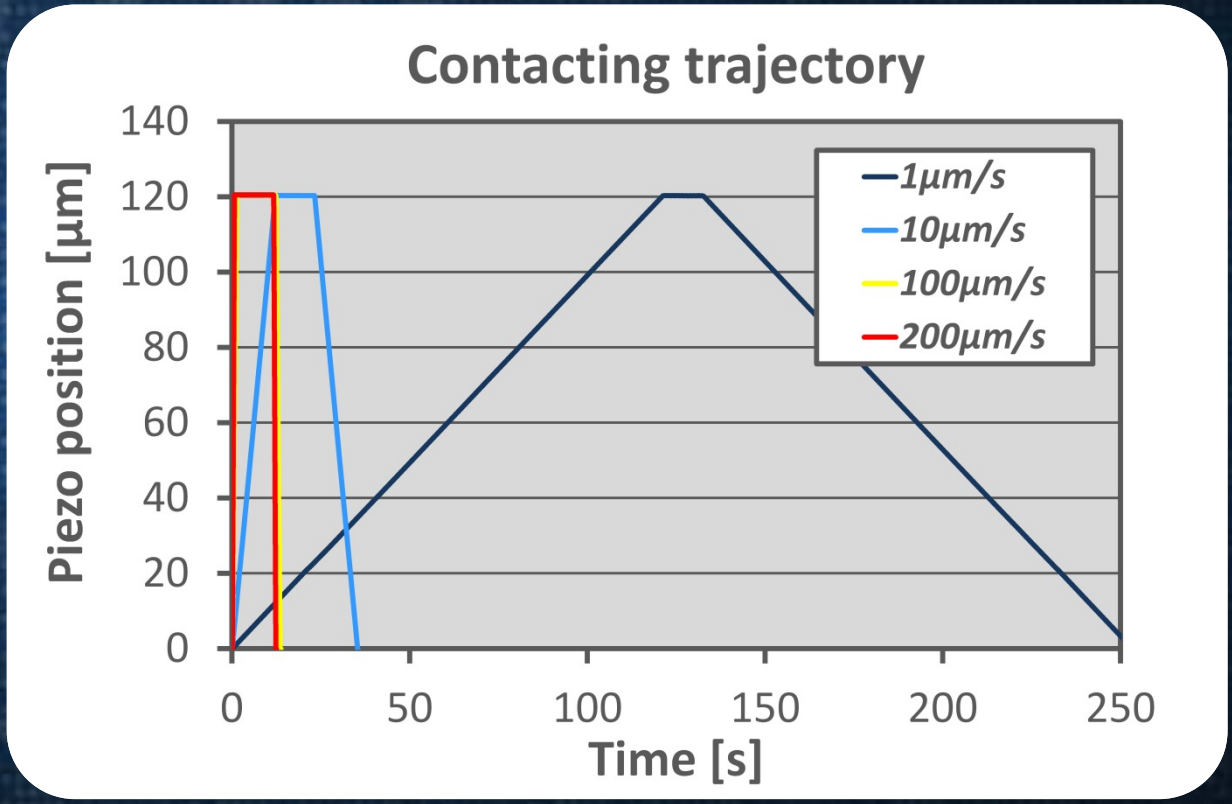
Influence?

- Velocity at Touch Down
- Relative movements

Methods

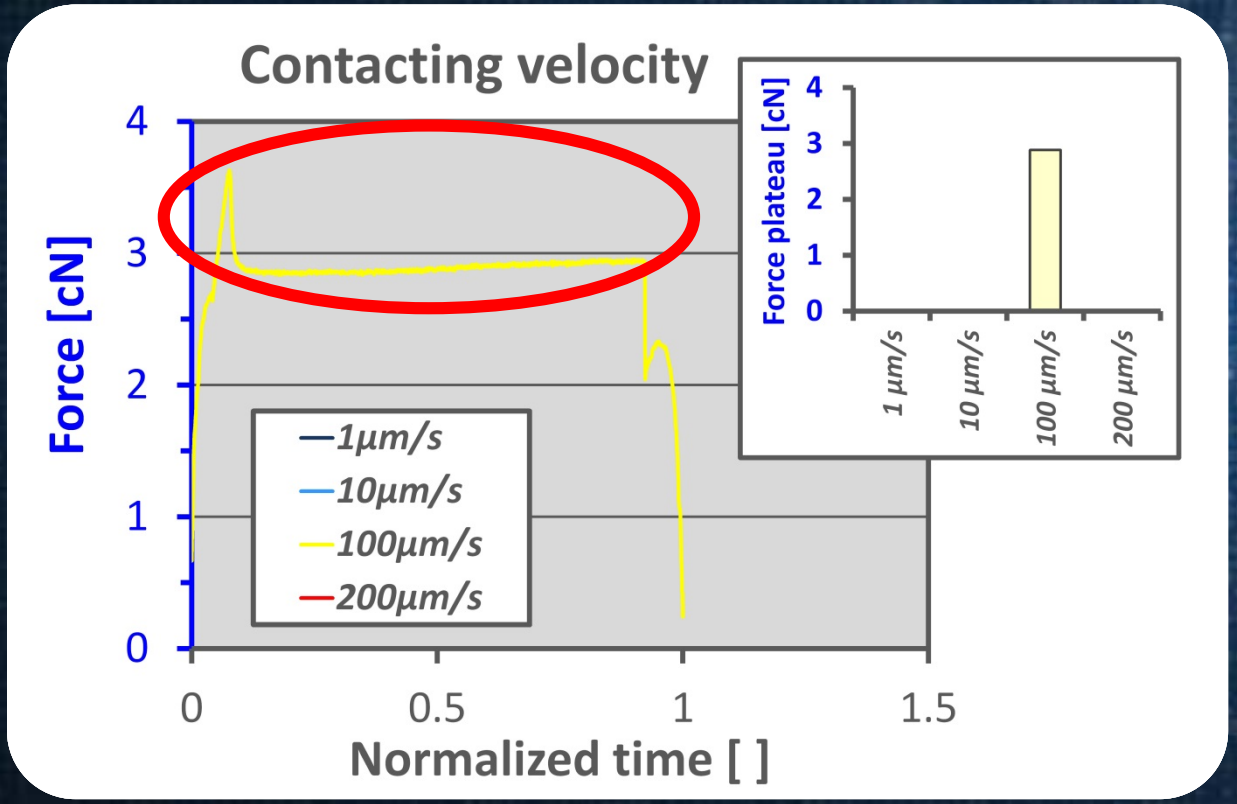
- Velocity at Touch Down

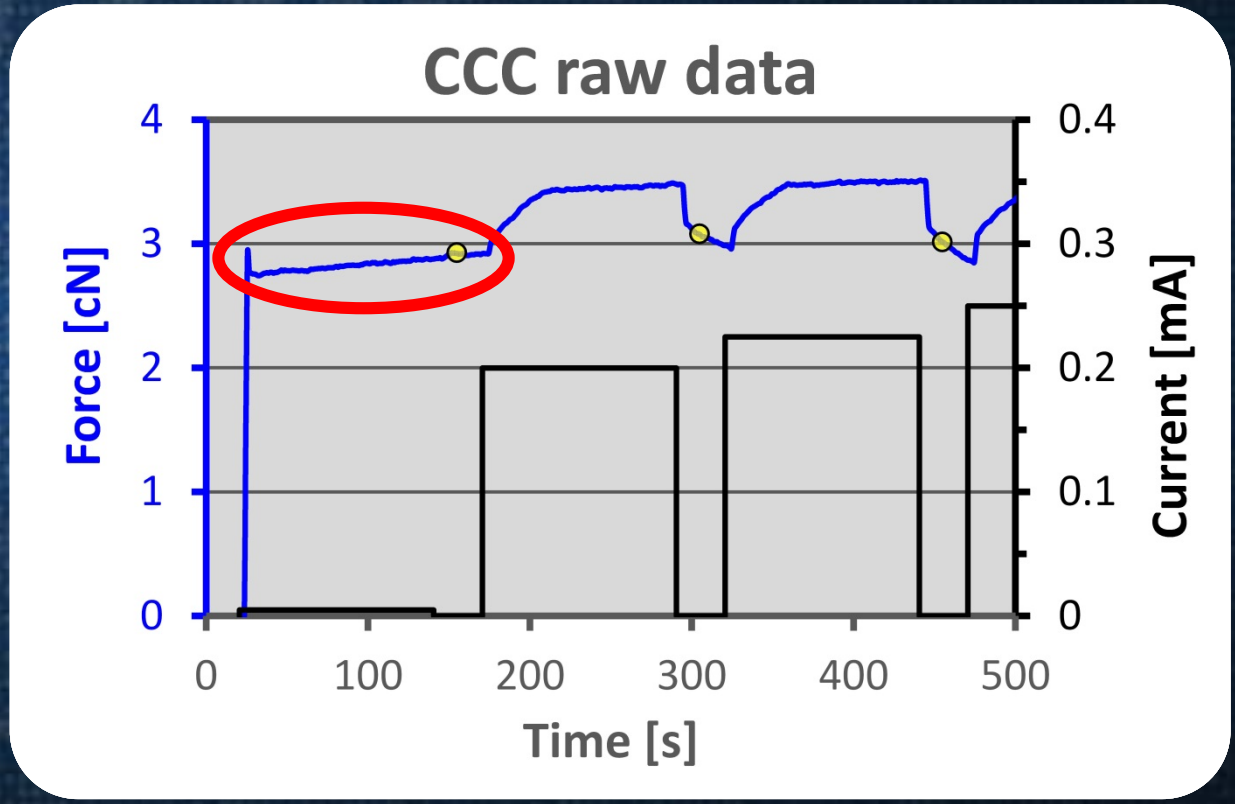




Methods

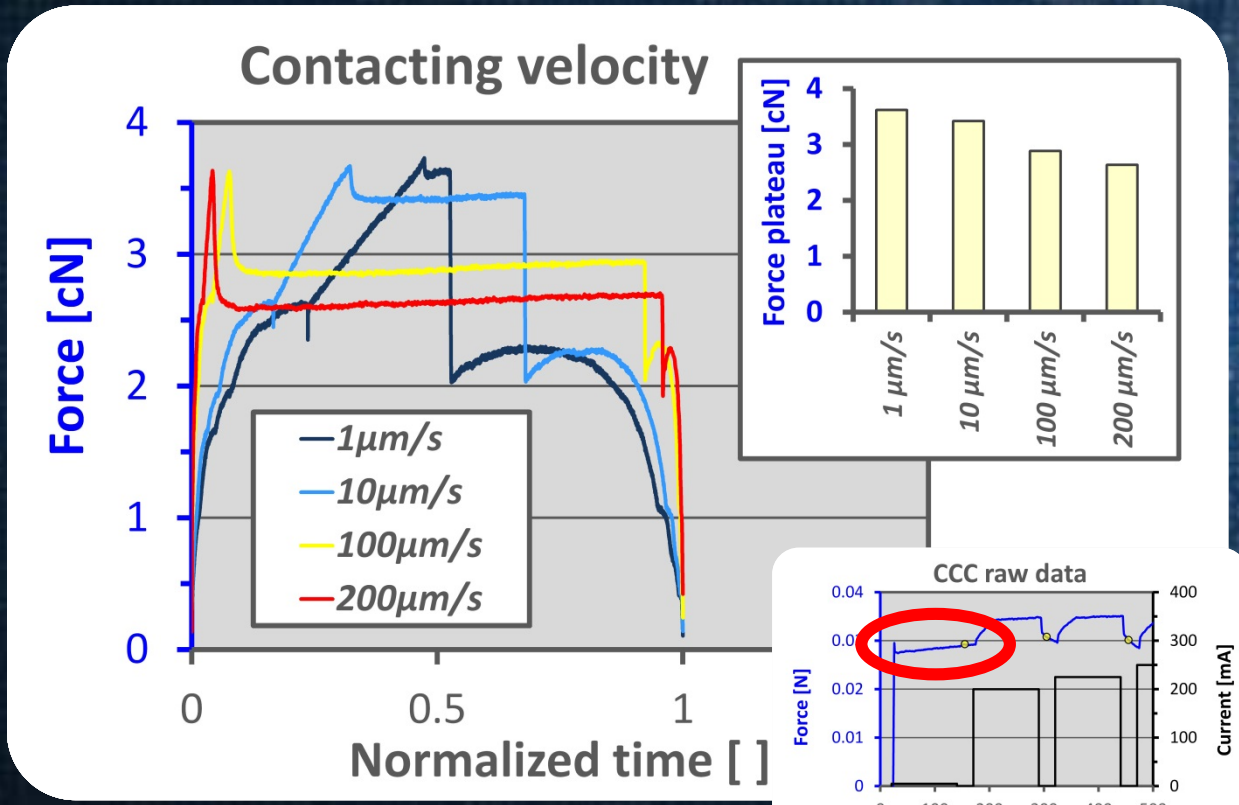
- Velocity at Touch Down

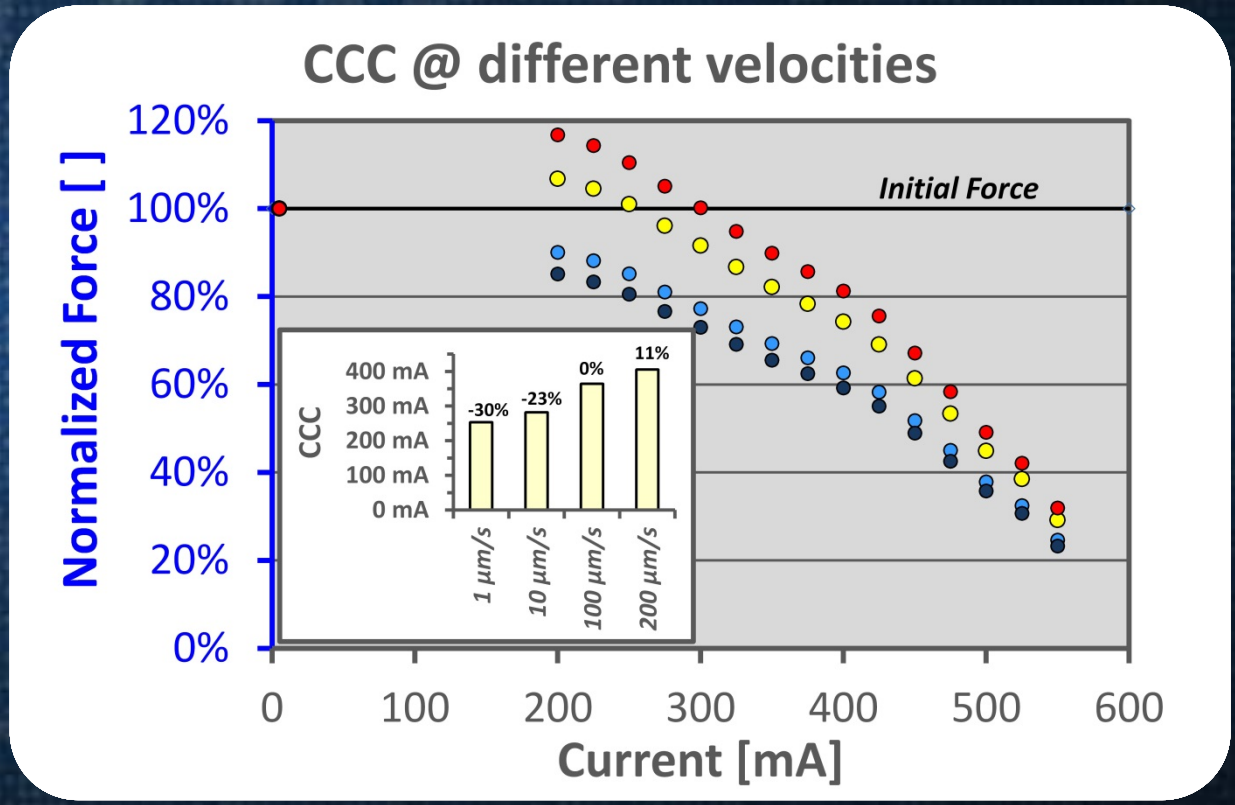




Methods

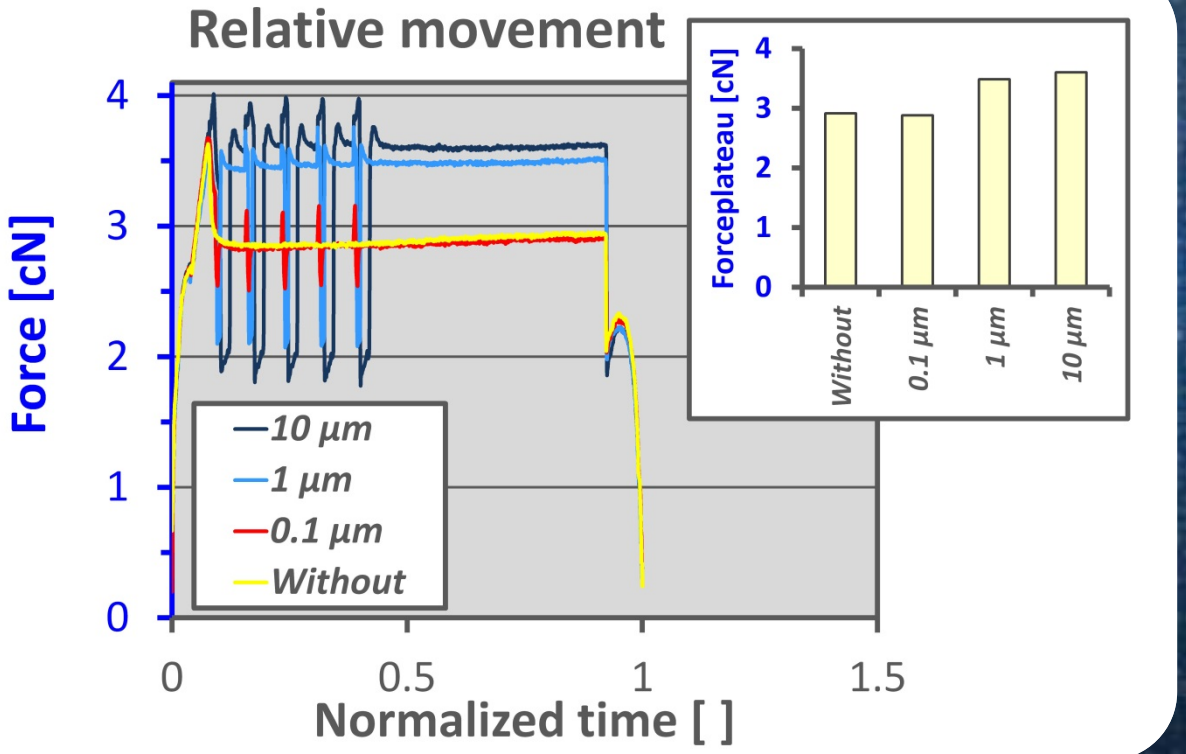
- Velocity at Touch Down

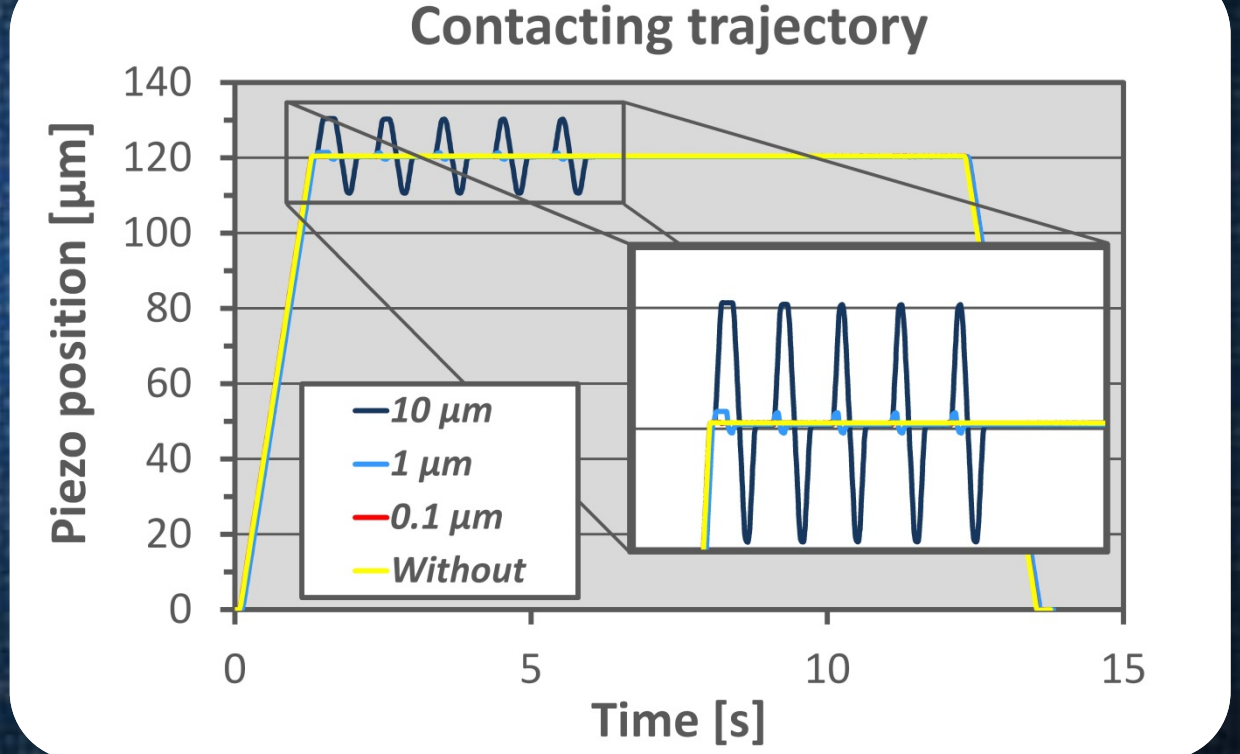




Methods

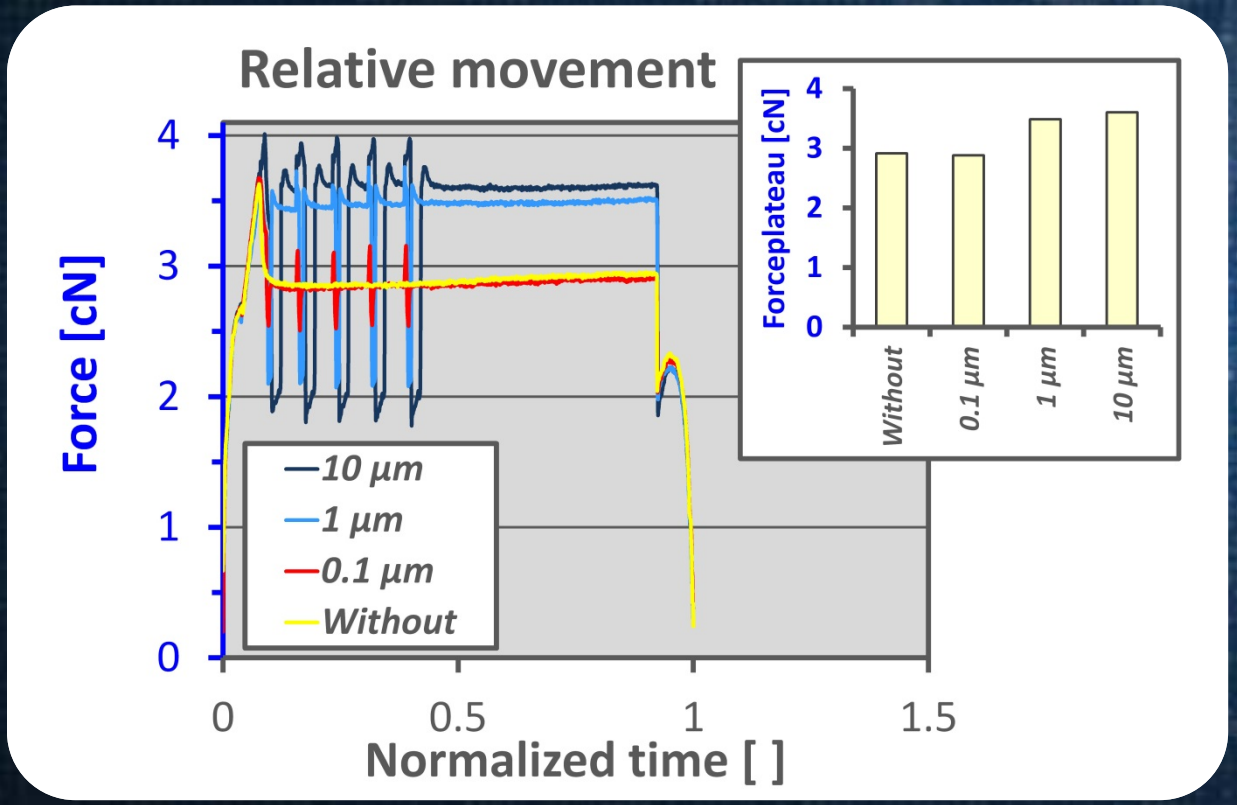
- **Relative Movements**

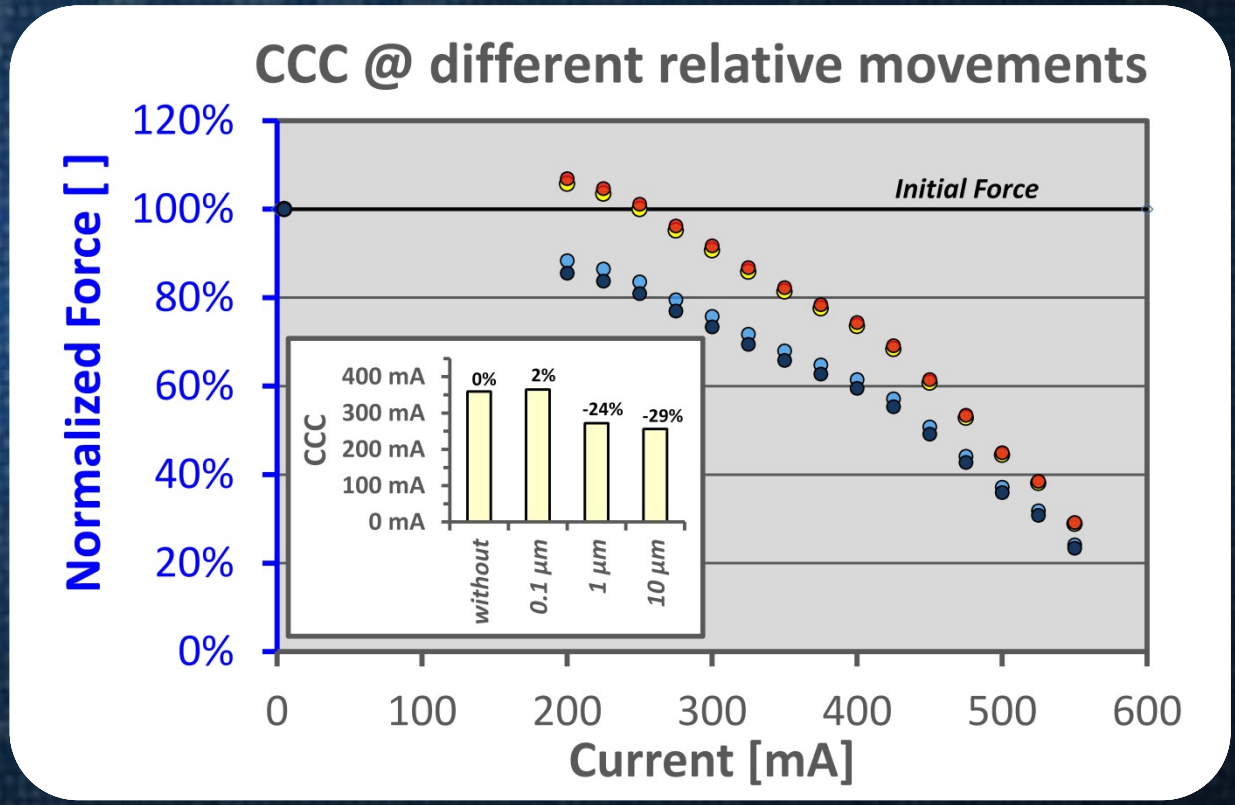




Methods

- **Relative Movements**





Methods

- **Influence on the CCC Result**

Better understanding of CCC-data needed

CCC according to ISMI 2009

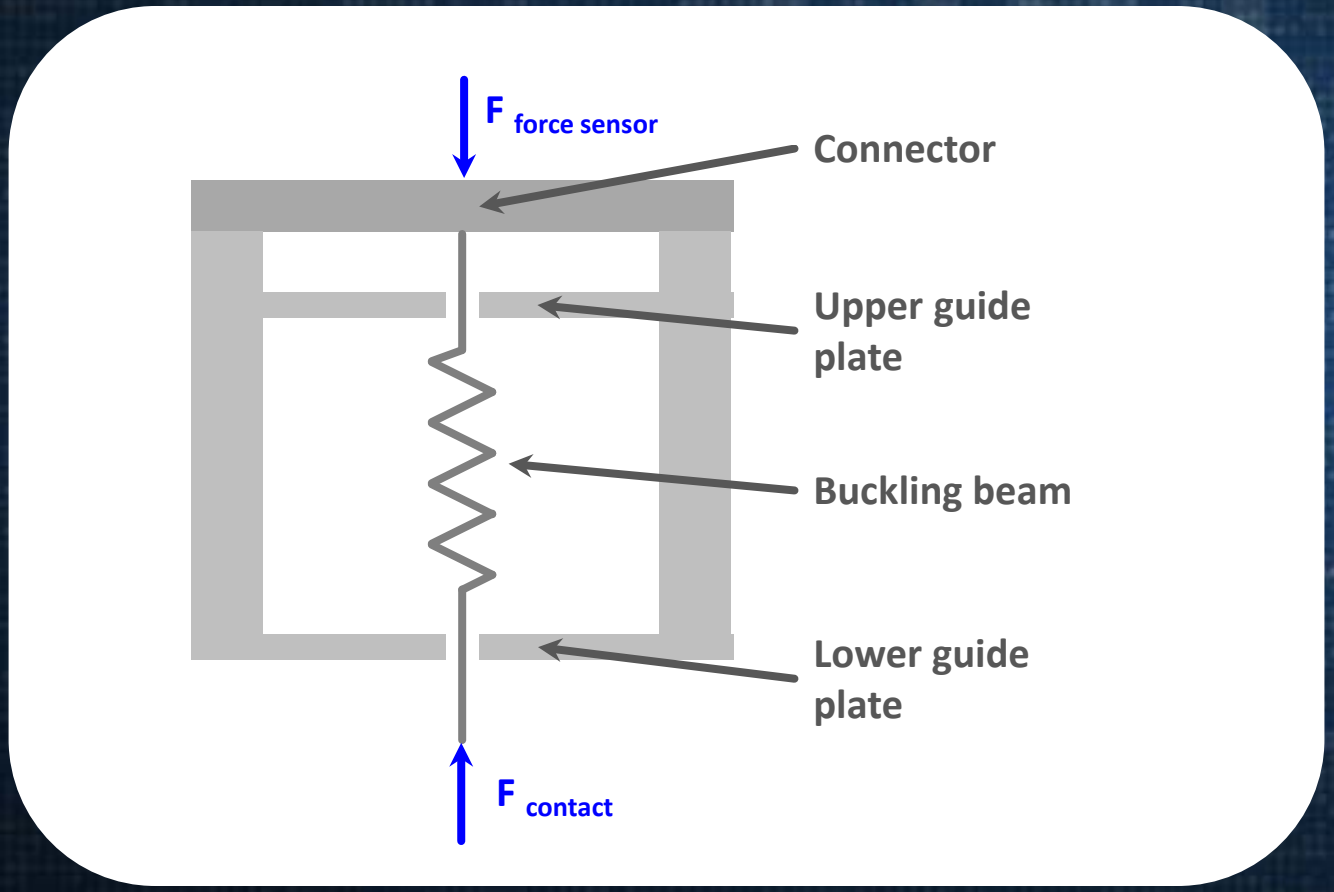
Vertical probe card technology

➔ *DO WE COMPARE **COMPARABLE FORCES**?*

  - Evaluation position of the force
  - Initial force

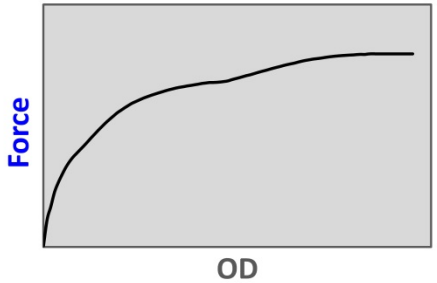
Methods

- **Understanding the CCC-Raw-Data**



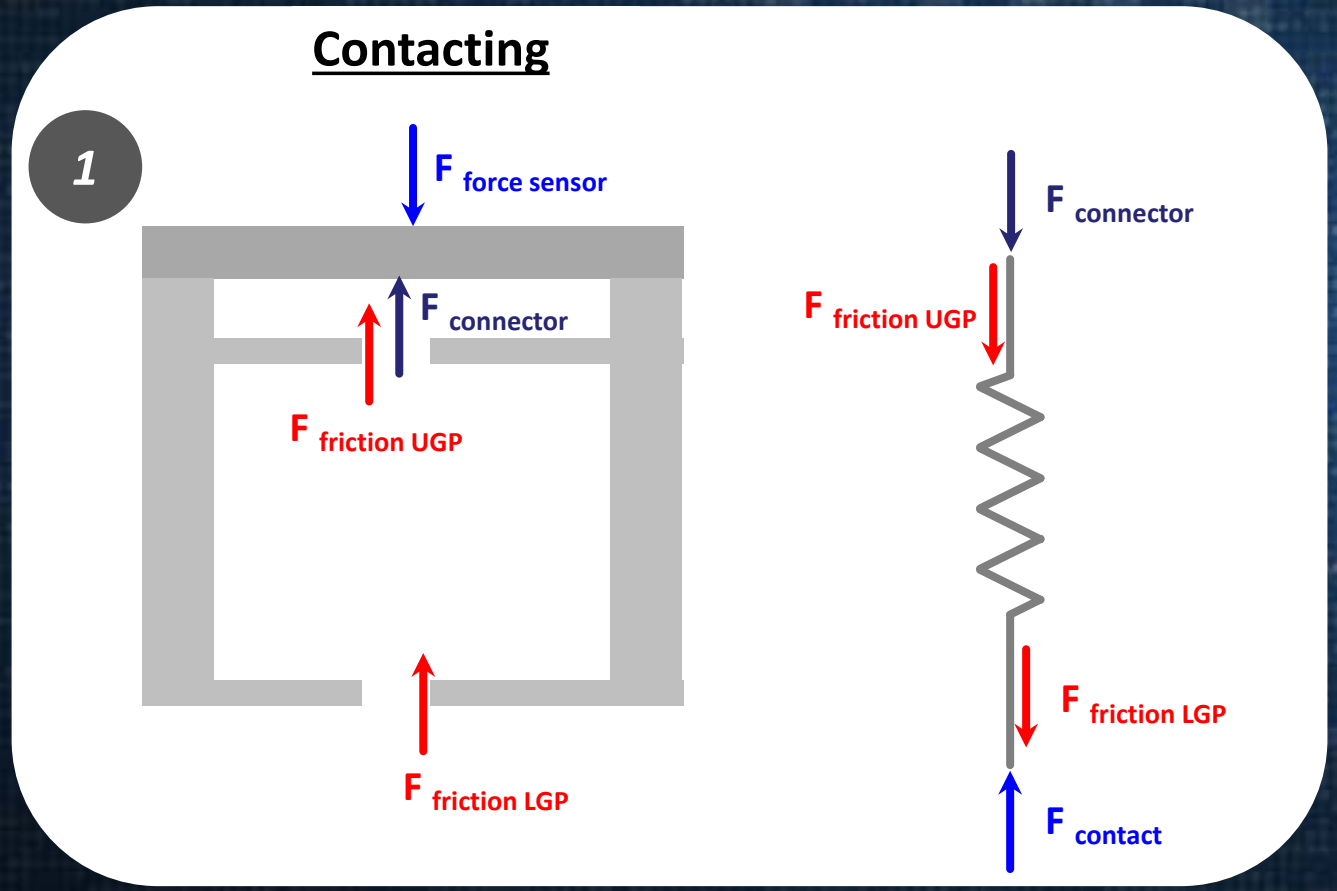
Simplified model

Buckling beam = Spring with a nonlinear spring constant



Methods

- Understanding the CCC-Raw-Data

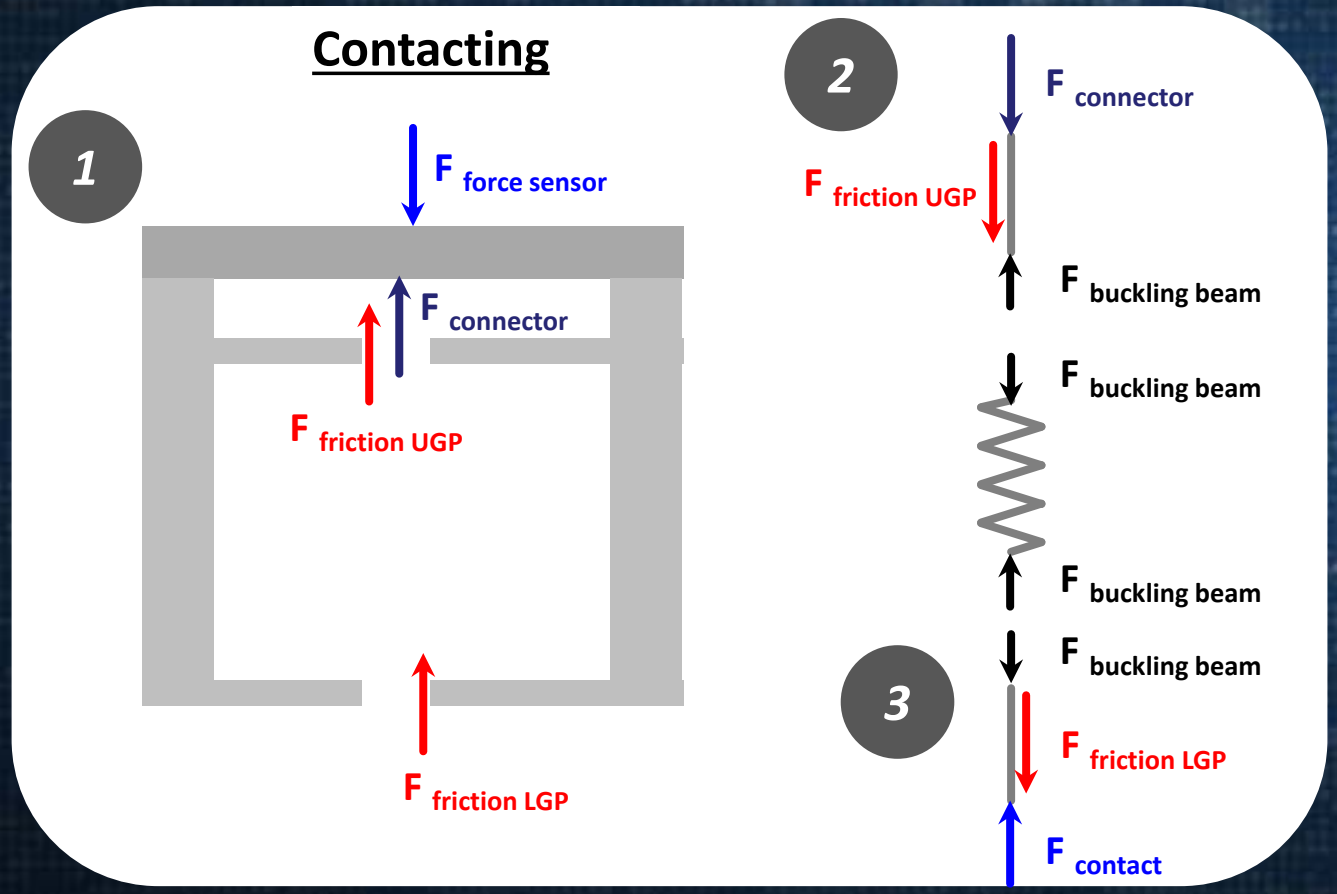


Free cutting and equilibrium of forces

$1: F_{force\ sensor} = F_{connector} + F_{friction\ UGP} + F_{friction\ LGP}$

Methods

- Understanding the CCC-Raw-Data



Free cutting and equilibrium of forces

$1: F_{force\ sensor} = F_{connector} + F_{friction\ UGP} + F_{friction\ LGP}$

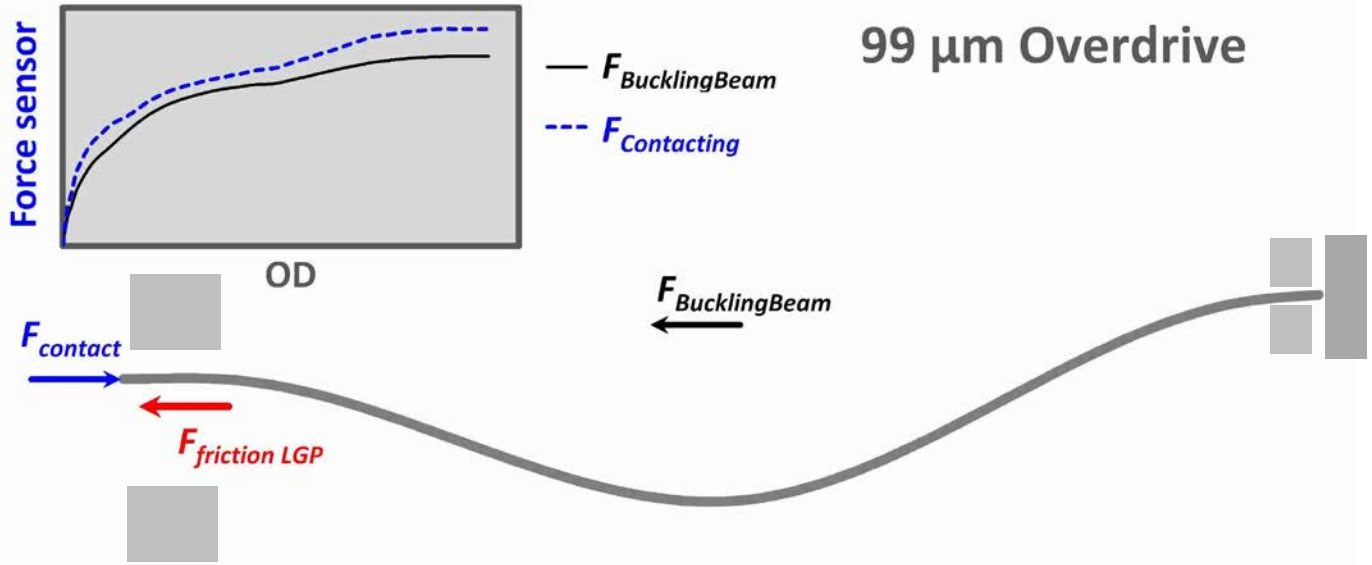
$2: F_{connector} = F_{buckling\ beam} - F_{friction\ UGP}$

$3: F_{contact} = F_{buckling\ beam} + F_{friction\ LGP}$

$\rightarrow F_{force\ sensor} = F_{contact} = F_{BucklingBeam} + F_{friction\ LGP}$

Methods

- **Understanding the CCC-Raw-Data**

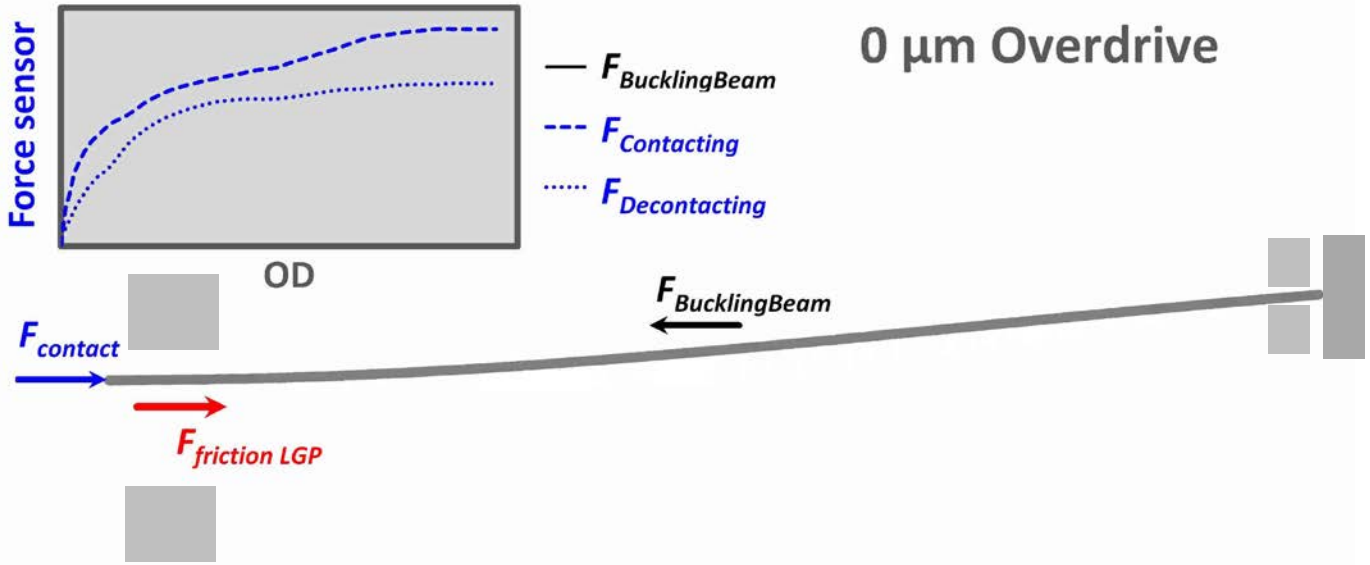


Contacting

➔ $F_{force\ sensor} = F_{BucklingBeam} + F_{friction\ LGP}$

Methods

- **Understanding the CCC-Raw-Data**



Contacting

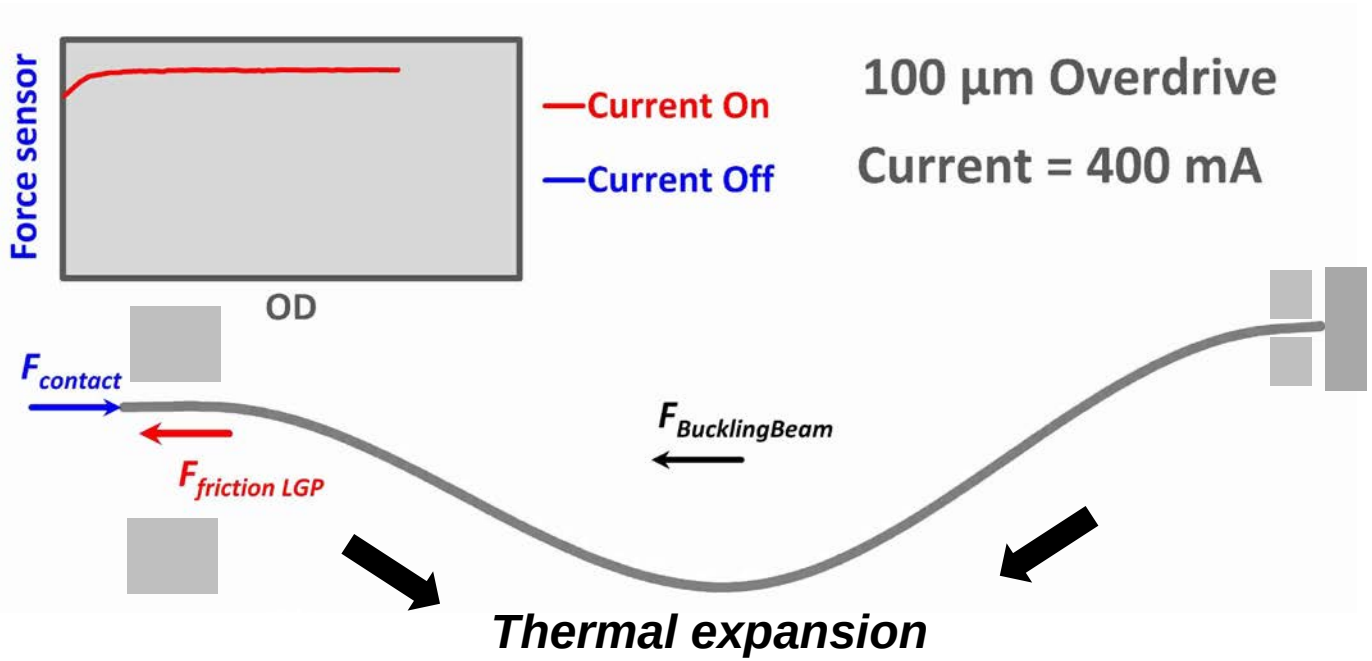
➔ $F_{force\ sensor} = F_{BucklingBeam} + F_{friction\ LGP}$

Decontacting

➔ $F_{force\ sensor} = F_{BucklingBeam} - F_{friction\ LGP}$

Methods

- **Understanding the CCC-Raw-Data**

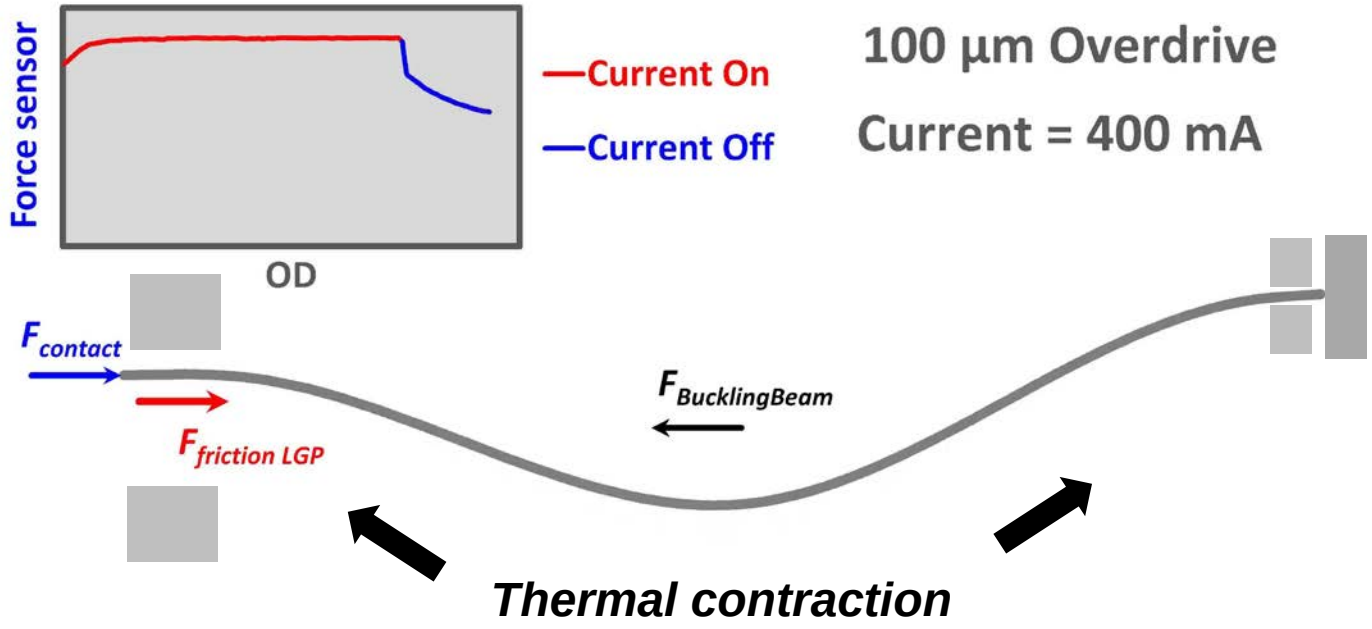


Current On

➔ $F_{force\ sensor} = F_{BucklingBeam} + F_{friction\ LGP}$

Methods

- **Understanding the CCC-Raw-Data**



Current On

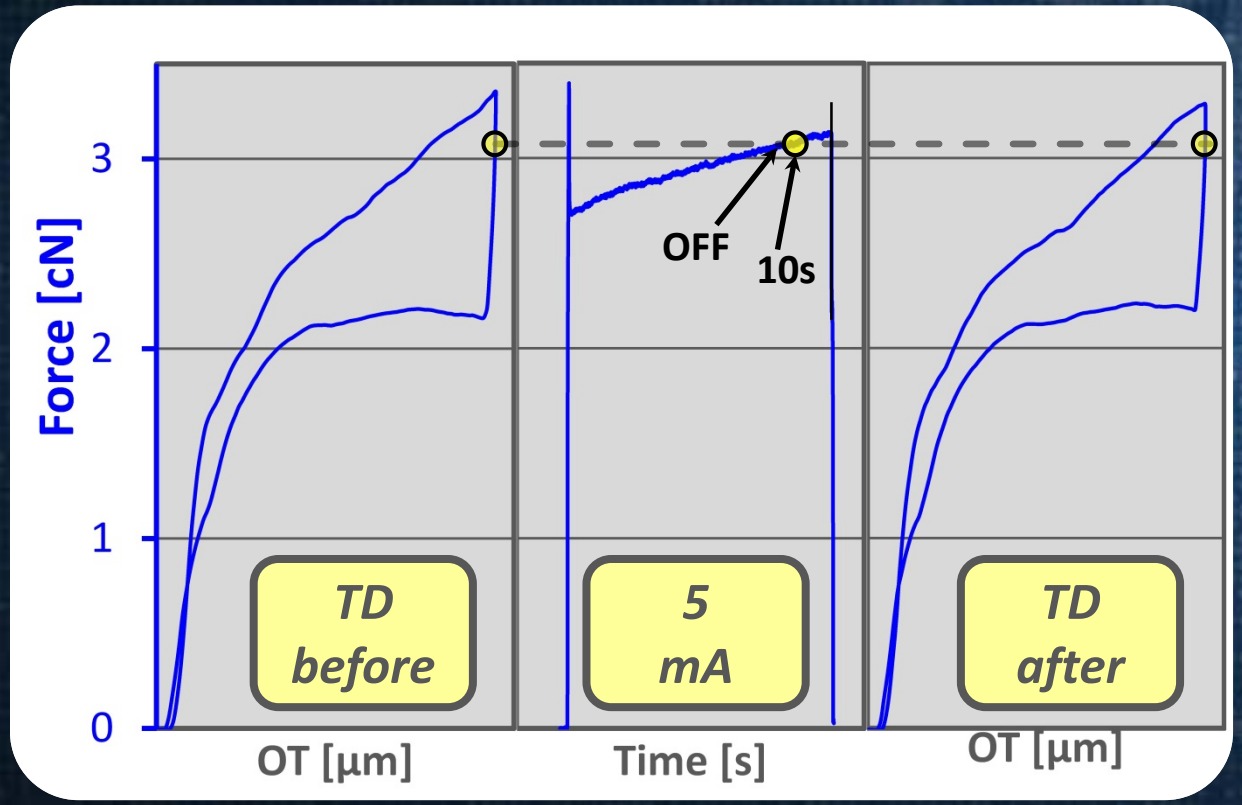
➔ $F_{force\ sensor} = F_{BucklingBeam} + F_{friction\ LGP}$

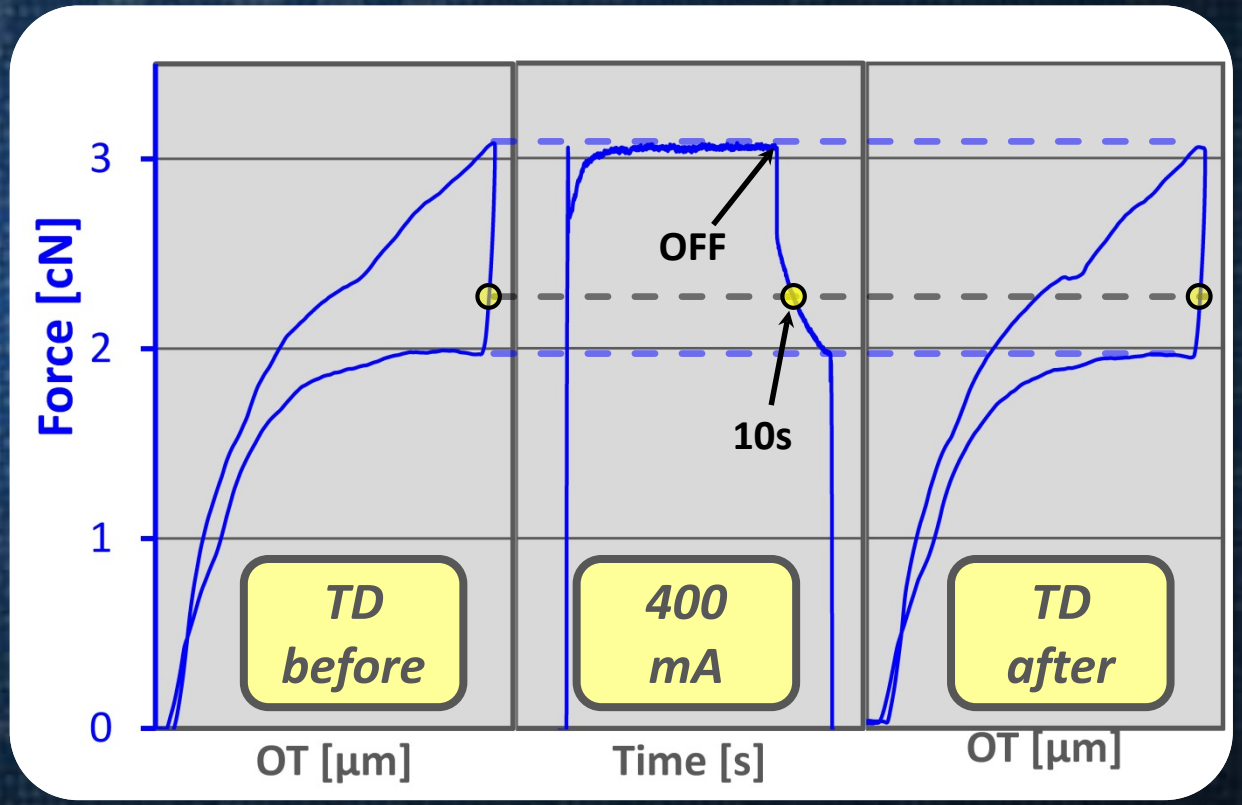
Current Off

➔ $F_{force\ sensor} = F_{BucklingBeam} - F_{friction\ LGP}$

Methods

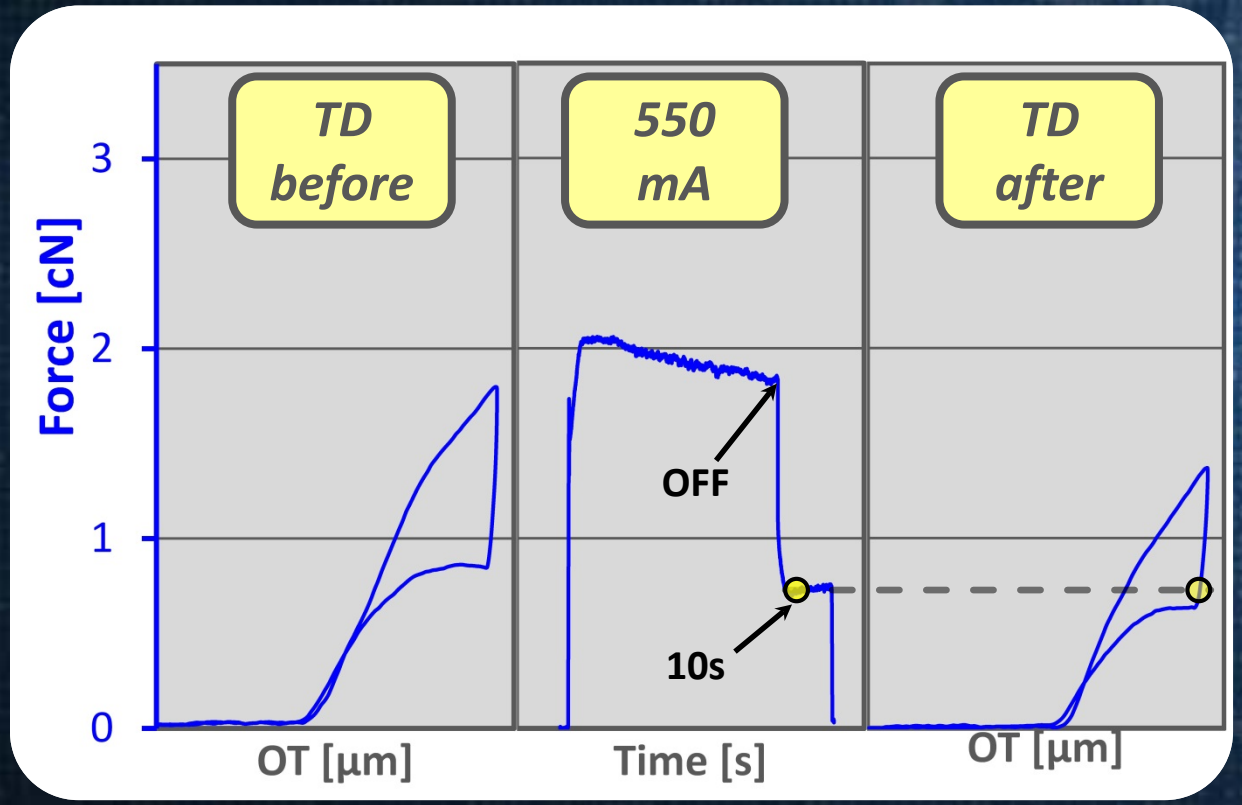
- Force vs. Overdrive Plots Before and After Current Load





Methods

- **Force vs. Overdrive Plots Before and After Current Load**



CCC according to ISMI 2009

Vertical probe card technology

➔ *The **FORCES** are not comparable*

Methods

- **More Comparable Method**

FORCE measurements
@ nominal overdrive
between
the different current steps

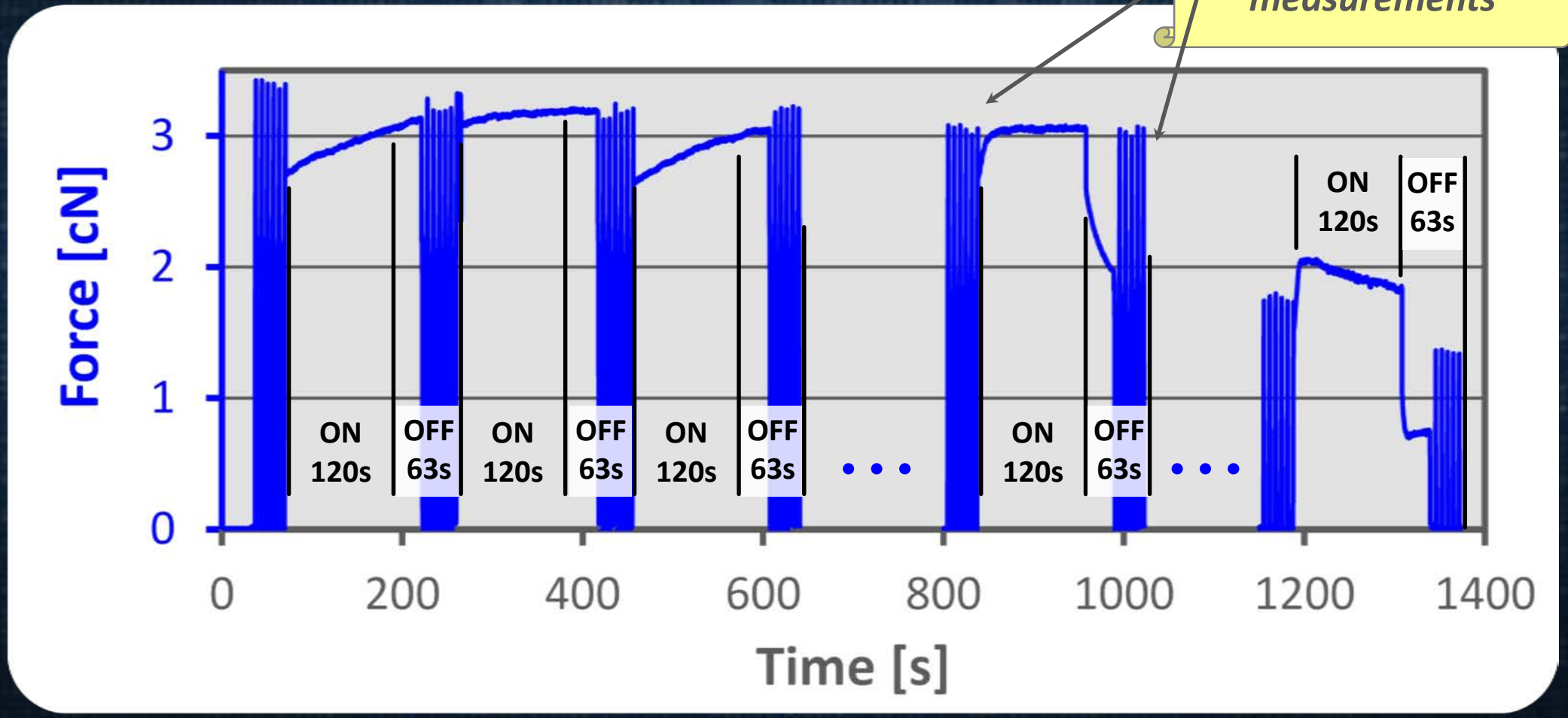
Comparable forces!

1. *5 FORCE measurements @ nominal Overdrive*
2. *Next CURRENT step applied 120 s CURRENT ON*
3. *30 s CURRENT OFF*
- *x. Restart again with 1.*

End with 5 FORCE measurements @ nominal Overdrive

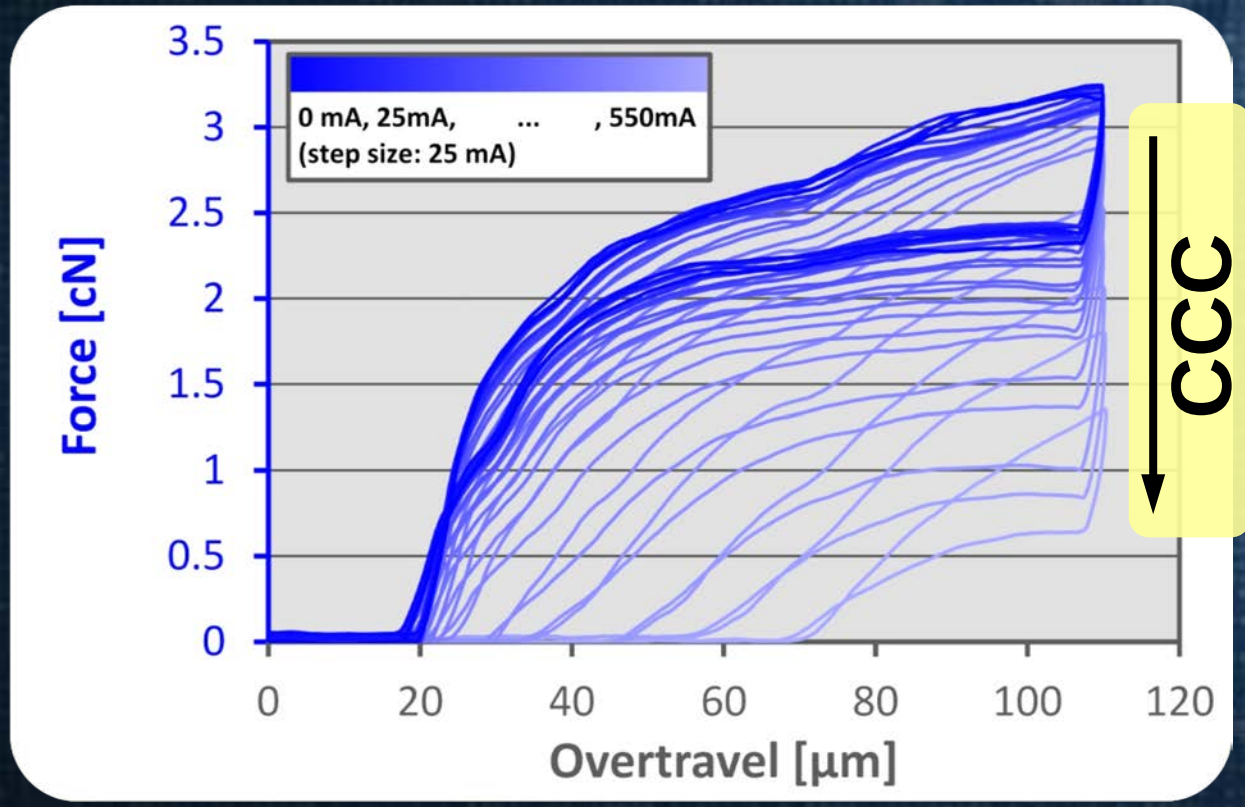
Methods

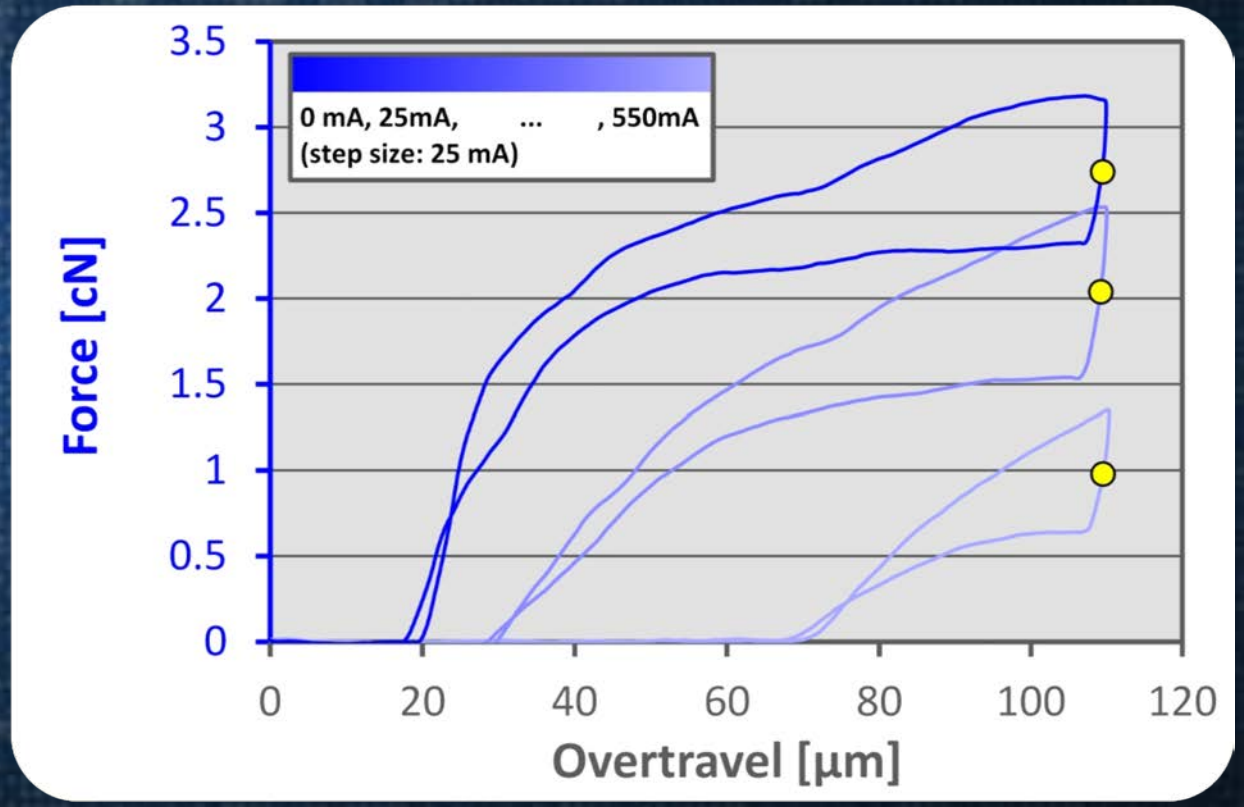
- **Better and More Comparable Method**



Methods

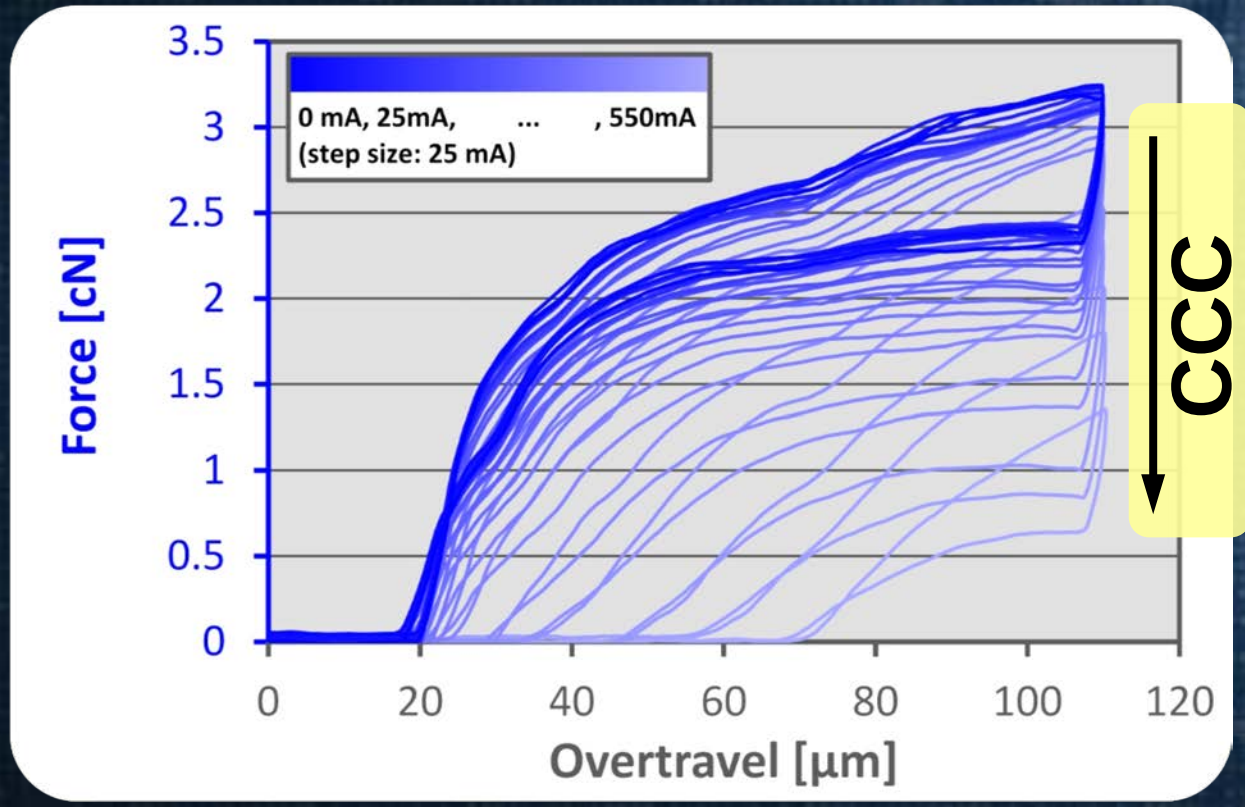
- **Better and More Comparable Method**

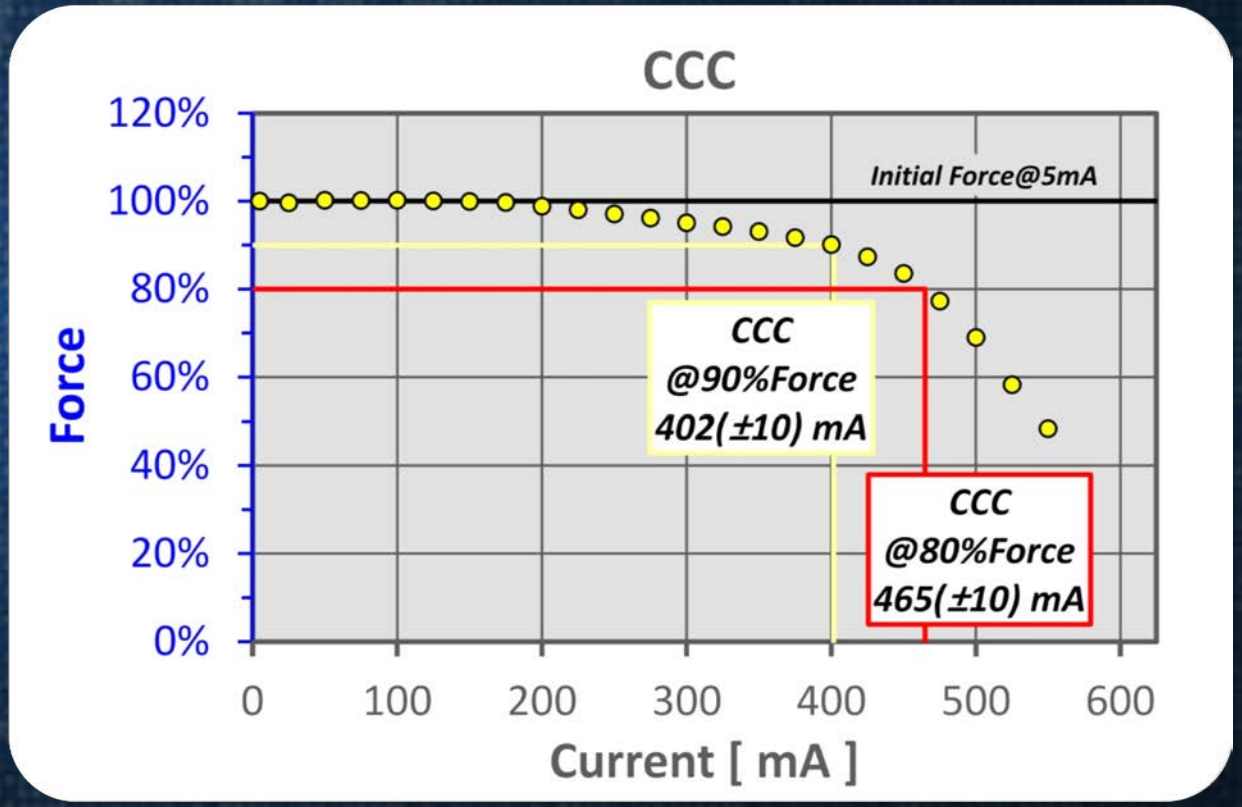




Methods

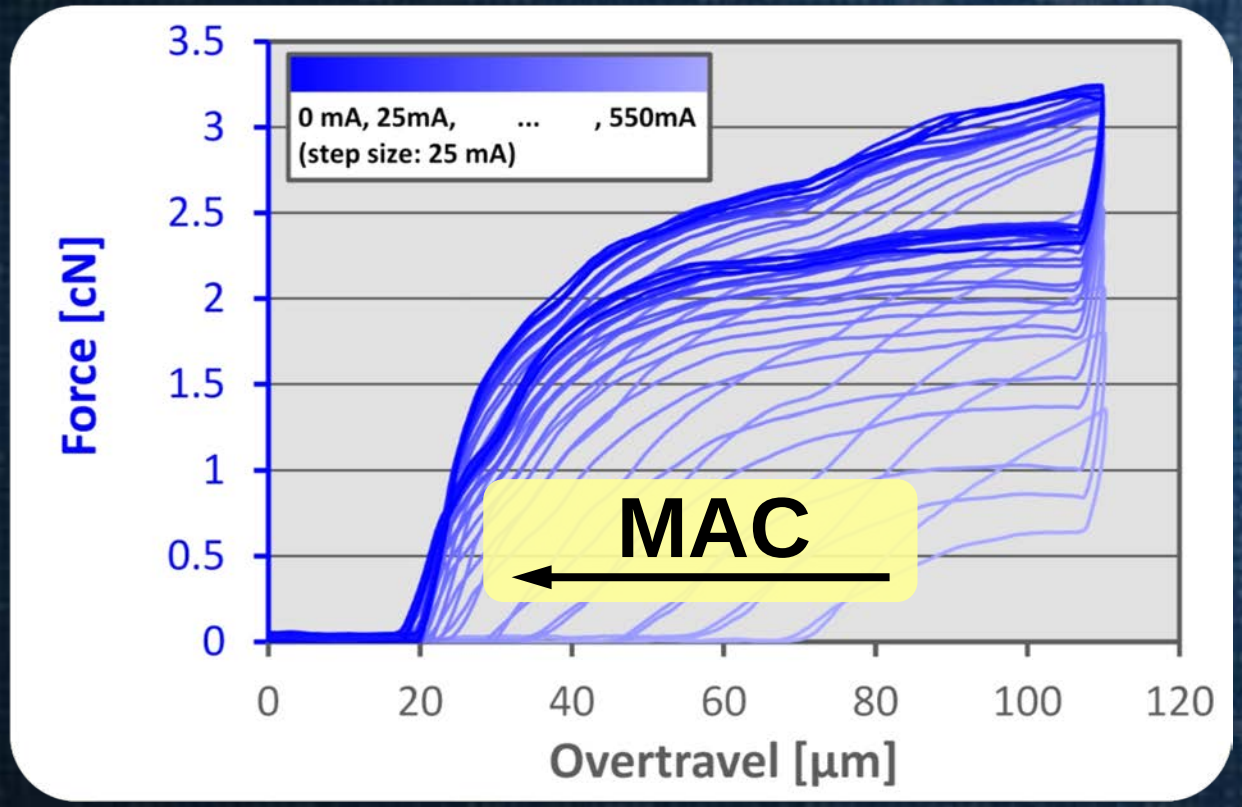
- **Better and More Comparable Method**

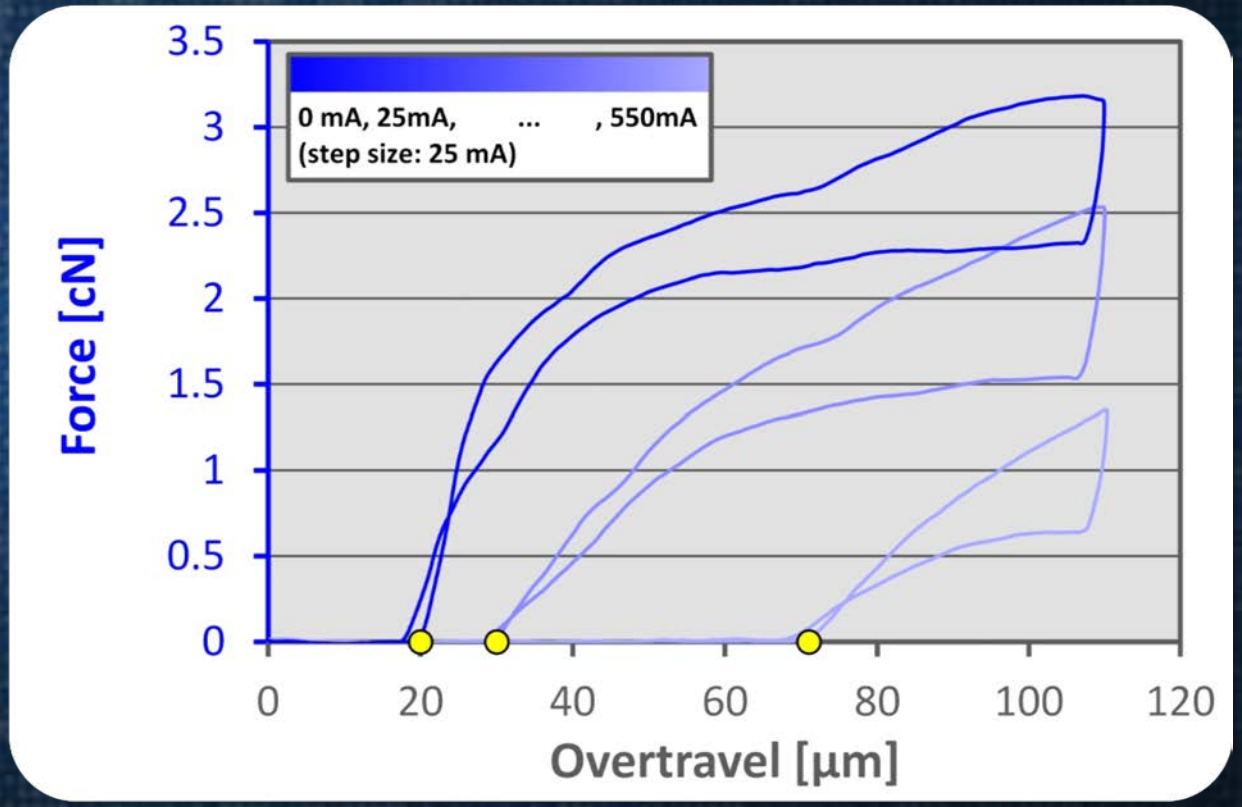




Methods

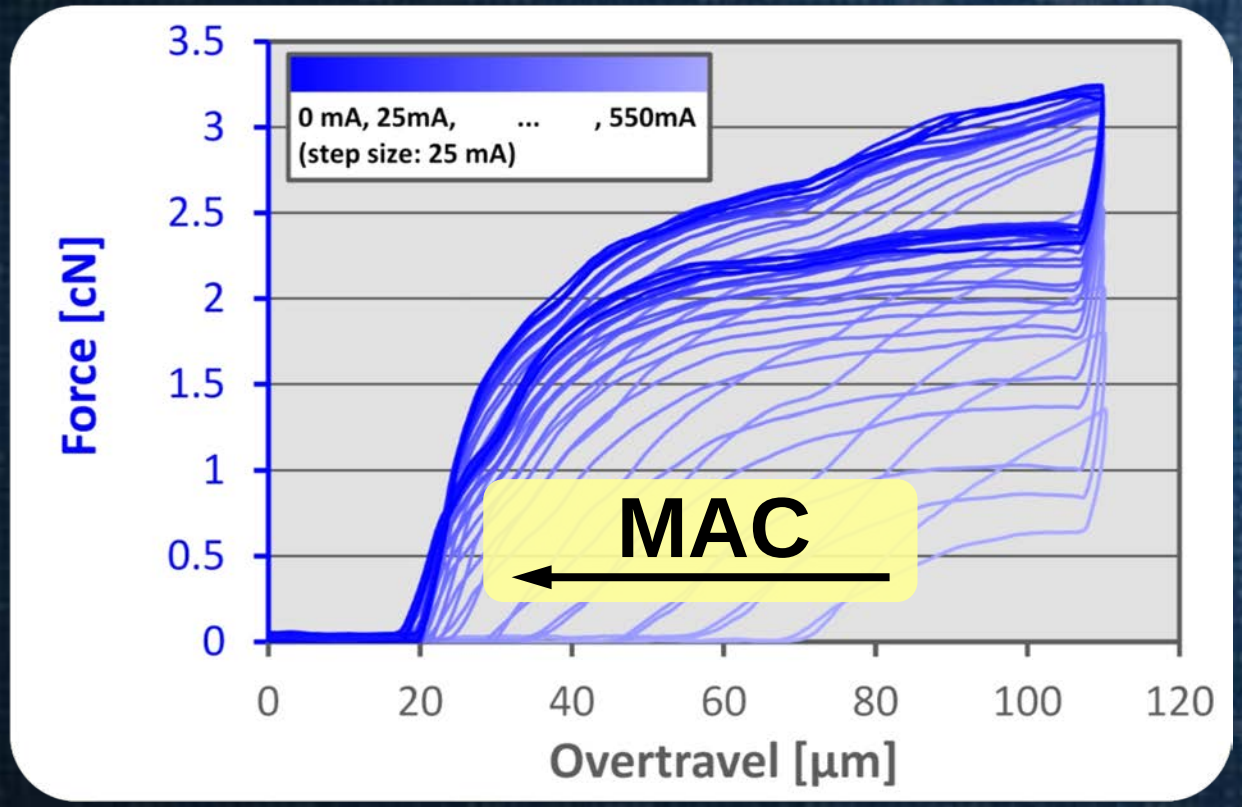
- **Better and More Comparable Method**

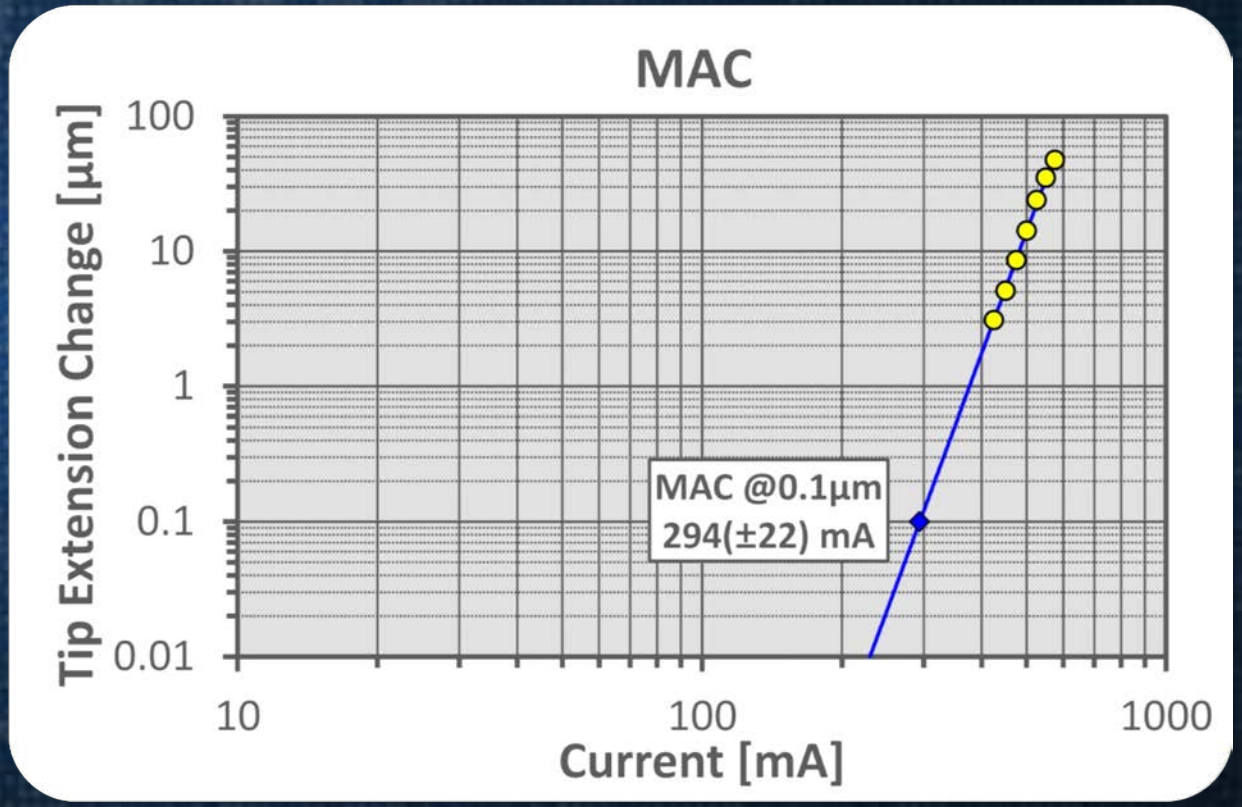




Methods

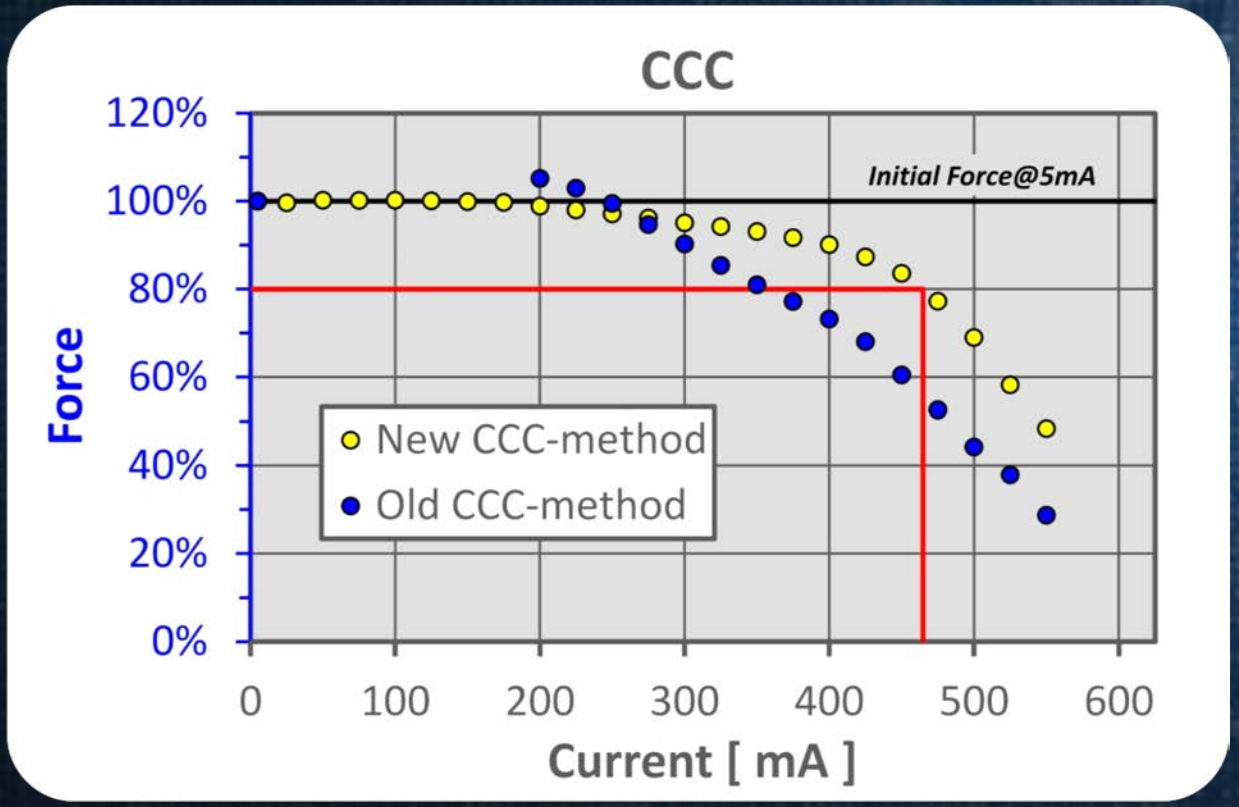
- **Better and More Comparable Method**





Results

- **Comparison: OLD vs. NEW Method**



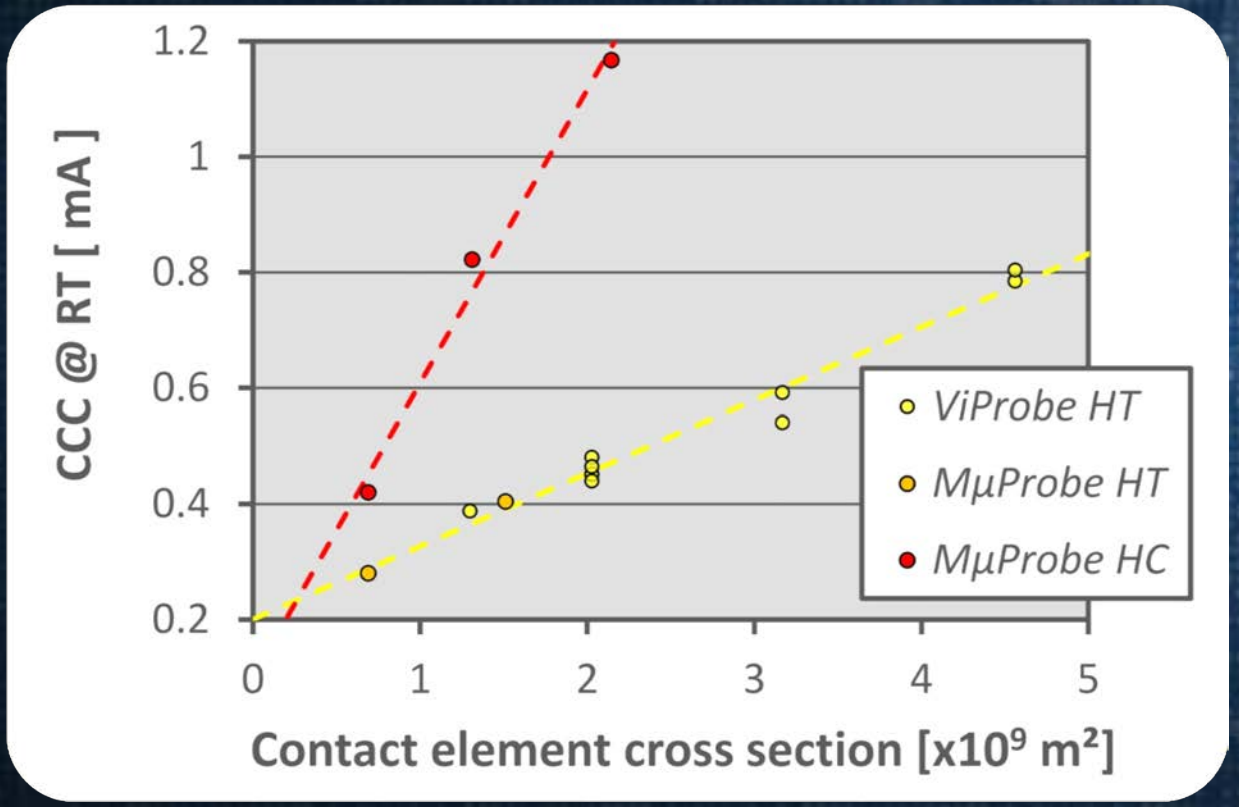
- *Higher CCC with new method*
- *Variance is much better*

(NEW: +/- 3% vs. OLD: +/- 10%)

➔ ***FORCE COMPARISON** is much more reliable*

Results

- **ViProbe & MµProbe**



CCC values correlate very well with the contact element cross-section

➔ ***Comparison of 2 different materials***
High temperature
Vs.
High Current

Conclusion

- **CCC (ISMI 2009)**

➔Vertical Probe Cards

➔ Comparison of not comparable forces

- **New method presented:**
  - CCC
  - MAC

➔Forces are comparable and more stable

Follow-On Work

- Pulsed Current Carrying Capability (PCCC)
- Numerical / Analytical Model (CCC and PCCC)
- Comparison CCC / PCCC with Real Environment Experiments

Acknowledgement

Thank you!

Lutz Benedix FEINMETALL GmbH	-	Head Design
Birgit Walloch FEINMETALL GmbH	-	Head & Probe Assembly, Mechanical Reliability Tests
Daniel Malitius FEINMETALL GmbH	-	Head & Probe Assembly, Mechanical Reliability Tests
Steffen Beutler FEINMETALL GmbH	-	Force & CCC Measurements