
SEVENTEENTH ANNUAL
BiTS
Burn-in & Test Strategies Workshop
March 6 - 9, 2016
Hilton Phoenix / Mesa Hotel
Mesa, Arizona
Archive- Session 7
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BiTS 2016 Burn-in & Test Strategies Workshop

Session 7
Mike Ramsey
Session Chair

BiTS Workshop 2016 Schedule

Solutions Day

Wednesday March 9 - 8:00 am

Very Touching

"Implementation of MEMS Particles Dramatically Improves Conventional Rubber Sockets"

Dave OH, Justin Yun, Kanghee Kim - TSE Co., Ltd.

"Contacting DC - 40GHz and beyond"

Tony Tiengtum - Xcerra Corporation

"Small Form Factor Sockets and Circuits for Silicon and Platform Validation"

James Rathburn - HSIO Technologies, LLC

"Prediction of Contact Mark for QFN package"

Yuanjun Shi - Twin Solution

Prediction of Contact Mark for QFN package

Yuanjun Shi, R&D Twin Solution

Pro. Liang Fang, Soochow University

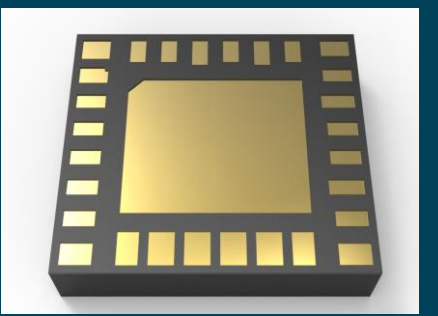
2016 BiTS Workshop
March 6 - 9, 2016

Contents

- Background & Objectives
- Experiment data Vs Hertz Contact Model
- Material Datasheet Derive
- FEA Model Setup
- Data Correlation
- Contact Mark Function
- Wear Out Experiment
- Summary + Future Plan

Background and objectives

Supplier	F	T	TS	TS	TS
First Pass Yield	98%	95%	90%	95%	99%
Insertions to first cleaning require	20K	100K	11K	3K	20K
Cleaning Frequency Continuous	2K	10K		2K	NA
Yield Drop To	90%	90%	50%	88%	NA
Contactor Material	Pd Alloy	Pd Alloy	Steel/ Au	Steel/ Au	Pd Alloy
Tip Style	4pt	R Tip	R Tip	R Tip	Sharp Tip
Contact force	30gf	25gf	27gf	31gf	31gf



- **Application:**
  - ① QFN NiPdAu Pad
  - ② 0.4mm pitch PA (2.4GHz)
  - ③ Rotatory Handler

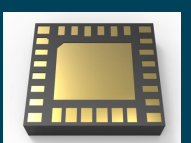
The primary objective of this work was to understanding how the contact tip interact with the device pad in terms of Sn or NiPdAu material.

Experiment Design

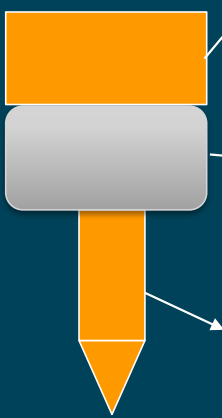
Indentation Depth

- Tip Design
  - 30^0 Radius
  - 30^0 Blade
- Contact Force
  - 10,15,20, 25,30,35, 40gf
- Pad Material
  - Matt Tin
  - NiPdAu

Force measurement



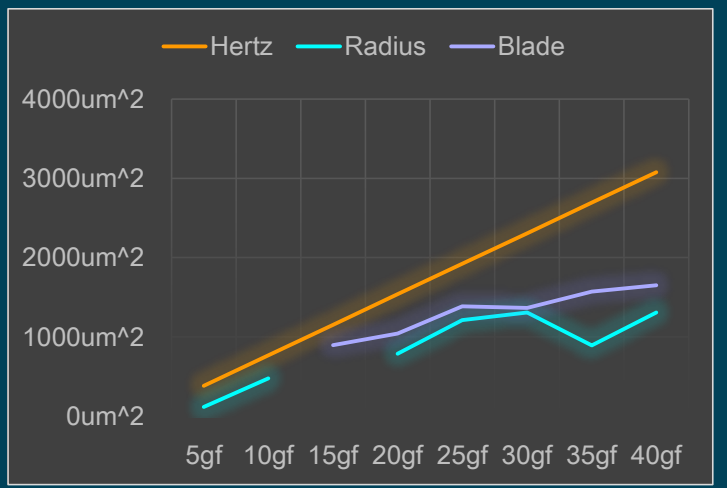
Test Setup

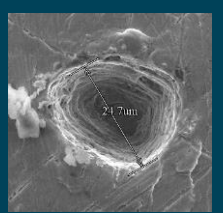


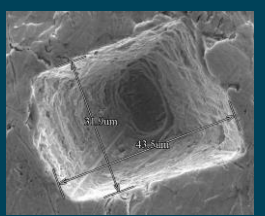
Prediction of Contact Mark for QFN package

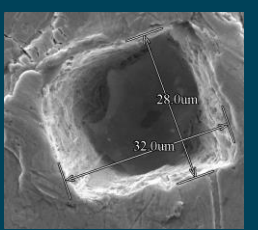
Measurement Data Vs Hertz Calculation

Pad Material : Matt Tin
Tip Radius: 8um

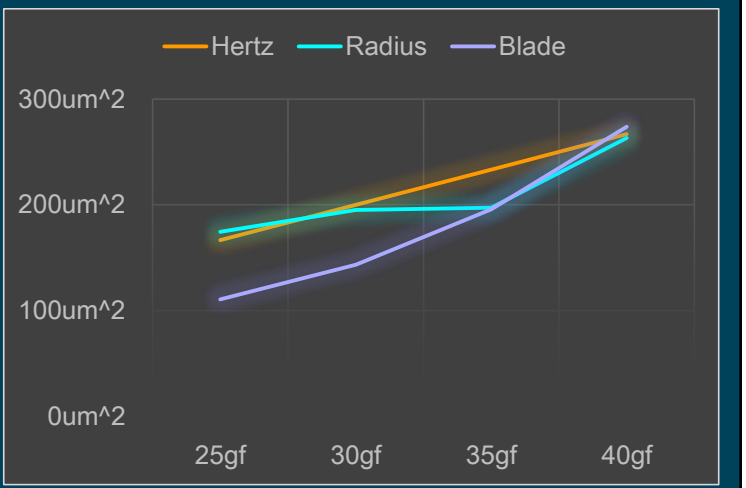




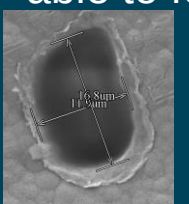


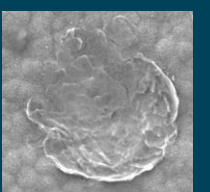


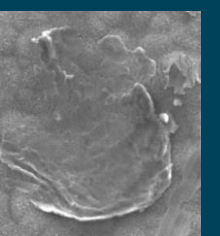
Pad Material : NiPdAu
Tip Radius: 10um



Contact force less than 20gf, not able to found the contact mark.



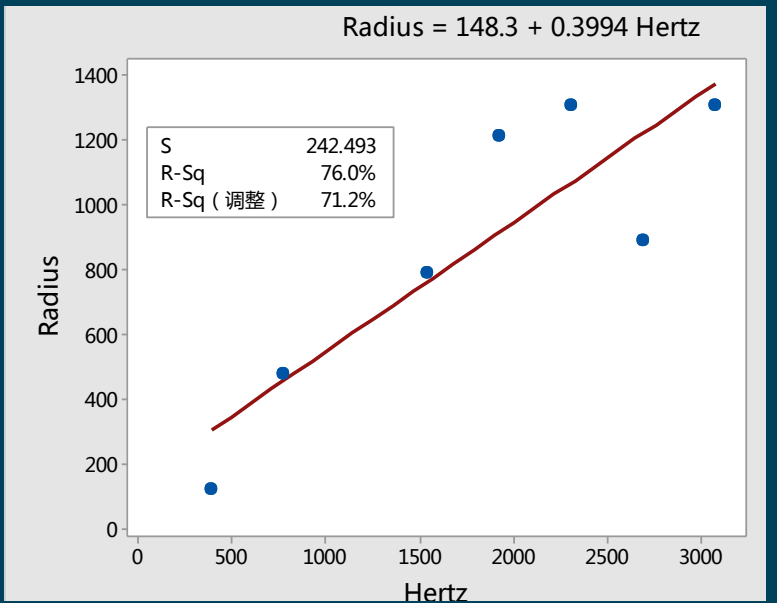


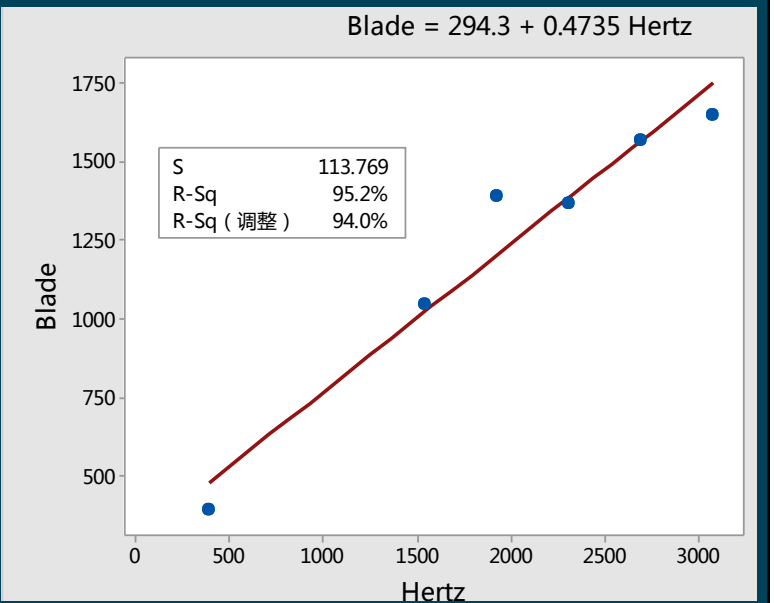


Prediction of Contact Mark for QFN package

Measurement Data Vs Calculation

Pad Material : Matt Tin

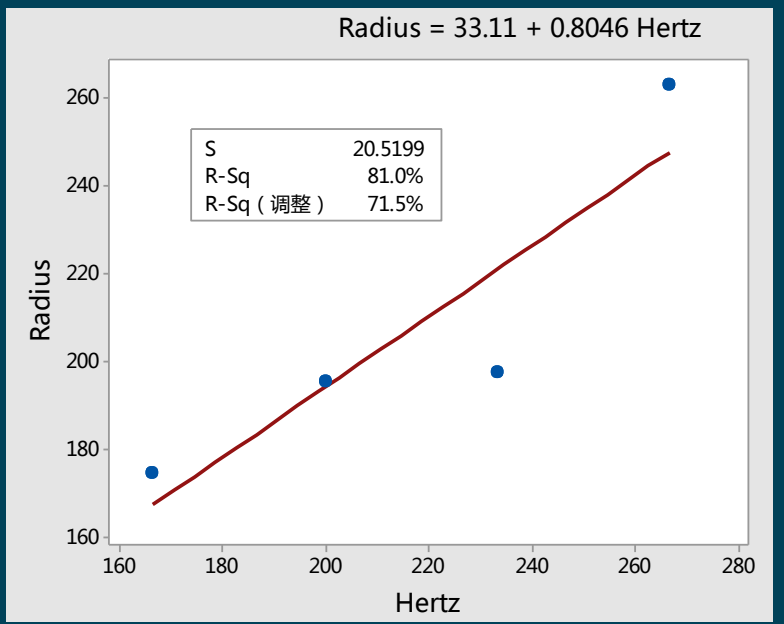


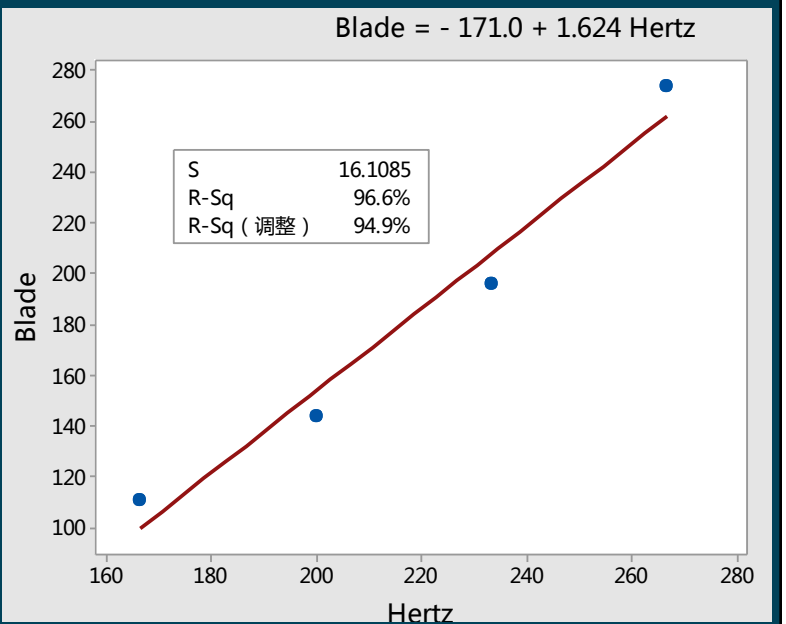


Based on the regression analysis, Hertz calculation is strong correlation to the blade tip design, middle level correlated to the radius tip design.

Measurement Data Vs Calculation

Pad Material : NiPdAu

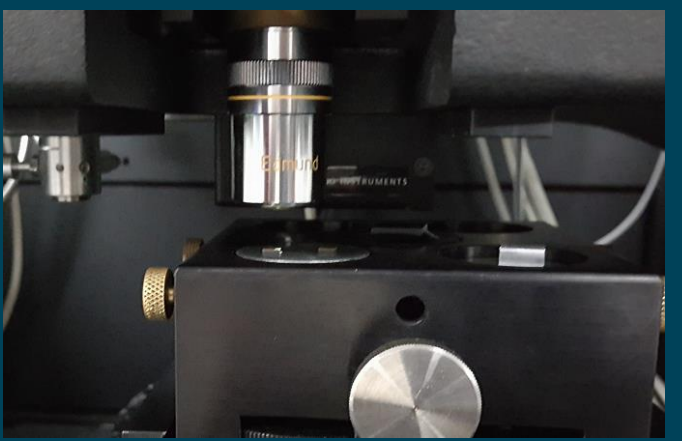




NiPdAu pad have the similar situation compared with the tin pad. Blade tip create most is plastic deformation, while the radius tip create both elastic and plastic deformation.

Material Datasheet Derive

MTS: Nano G200 (Nano Indenter)

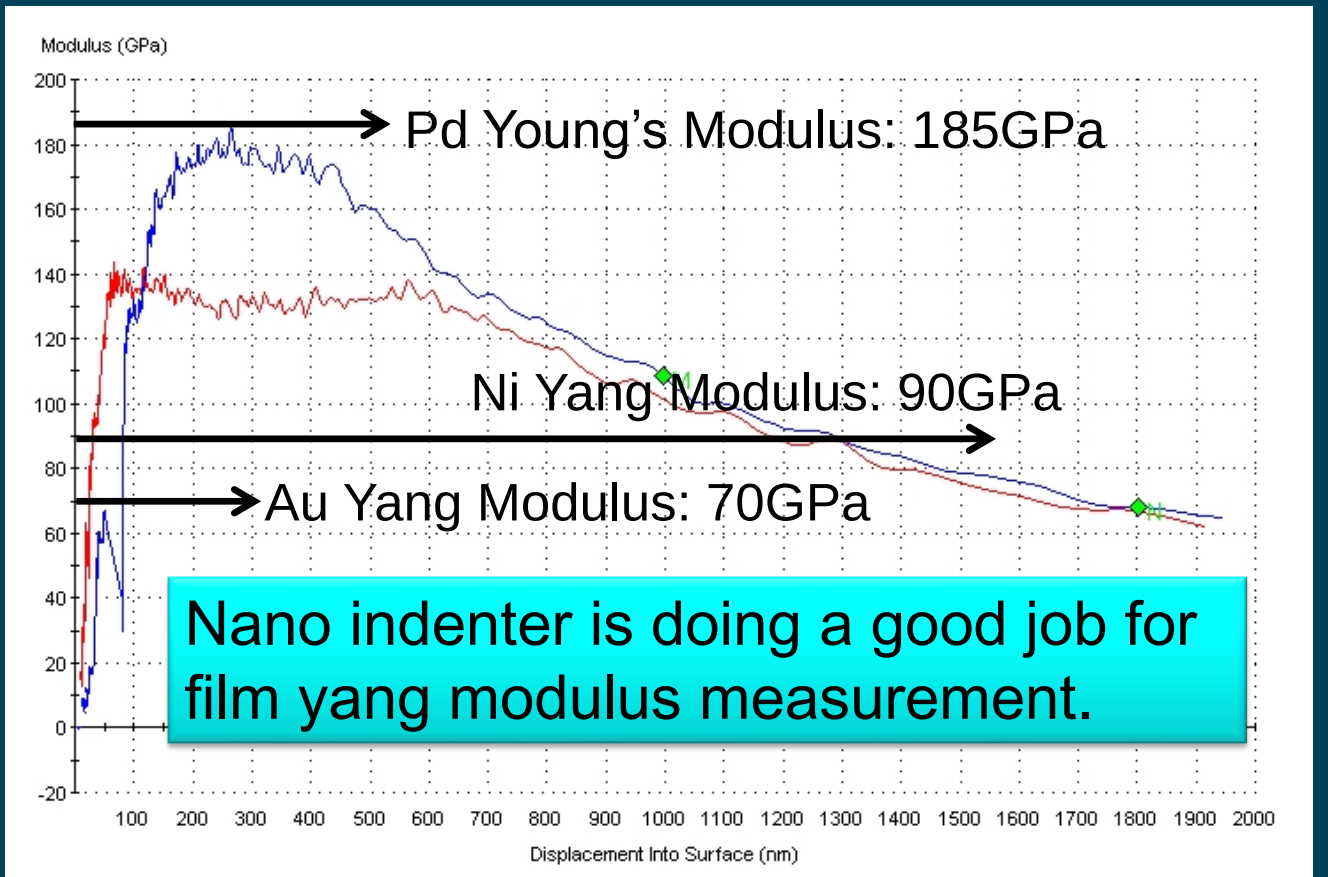


Data acquire for:

1. Young's modulus Vs Depth
2. Indention Depth Vs Load

Material Datasheet Derive

Pad Material : NiPdAu

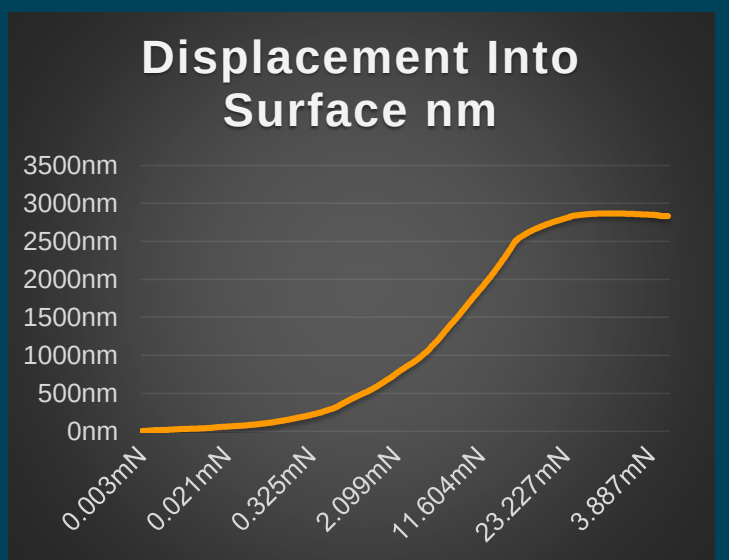


Material Datasheet Derive

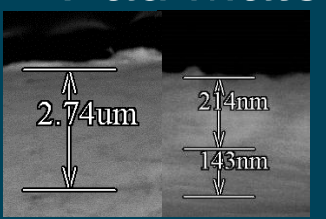
Pad Material : Matt Tin

① Young's Modulus: 37Gpa

Surface Approach V: 10nm/S
Frequency Target: 45Hz
Surface Approach Distance: 2500nm

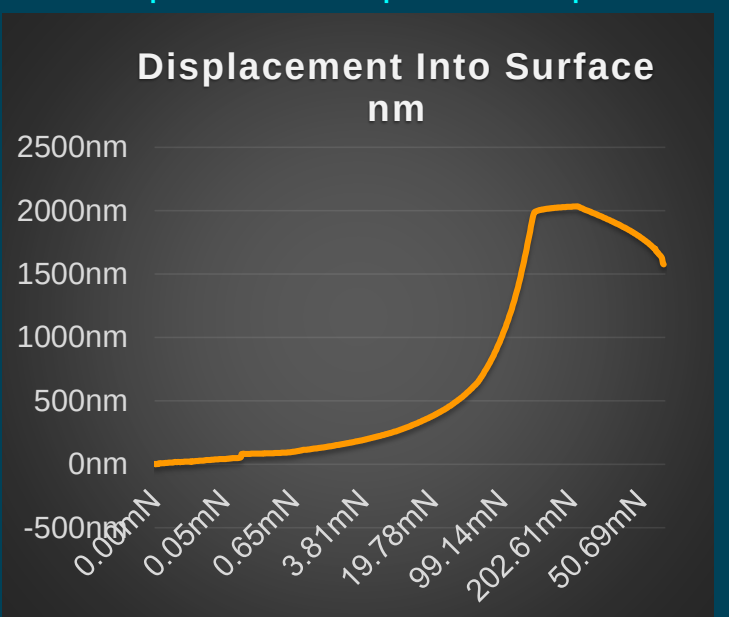


Pad Material : NiPdAu



Au: 0.2um
Pd: 0.15um
Ni: 3um

Au: 70Gpa, Pd: 180Gpa, Ni:90Gpa



Prediction of Contact Mark for QFN package

Material Data Correlation

FEA Model Setup

Tool:

① ANSYS Workbench

② IBM Computer

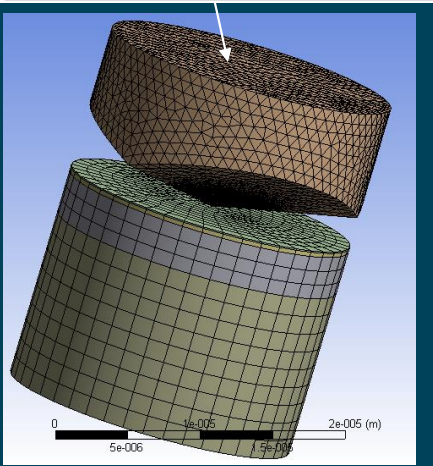
Node: 50

CPU: 100

Core: 200

Berkovich Indenter

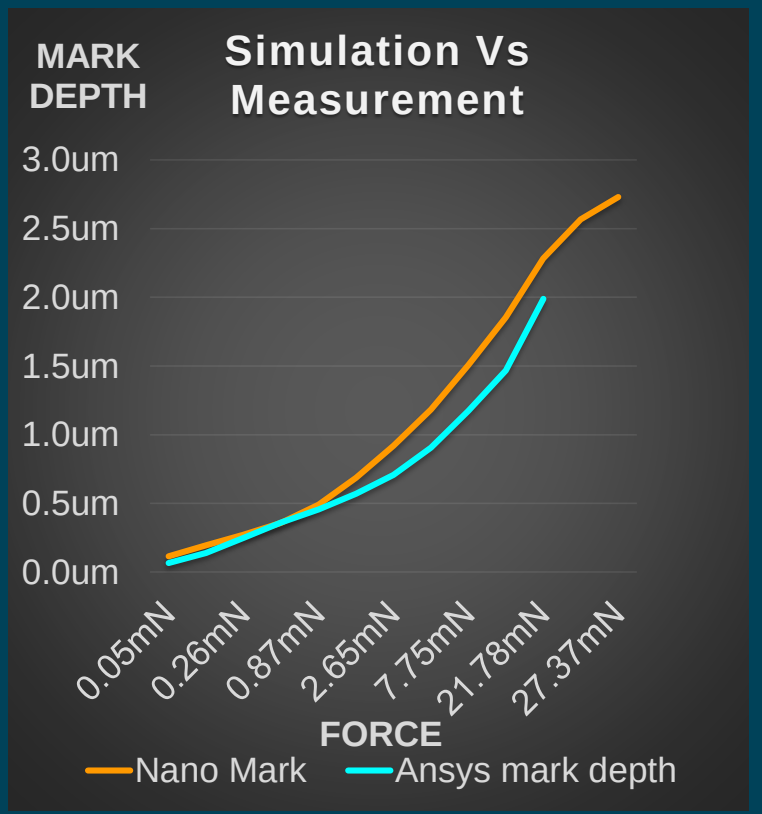
	Berkovich
Angle	65.3^{o}
Length	7.5315
Project Area	$24.56h^{2}$
Depth Vs Volume	$8.1873h^{3}$
Area Vs Volume	$0.067A^{3/2}$
Project Area Vs Surface Area	0.908
Equivalent Angle	70.32^{o}
Contact Radius	-



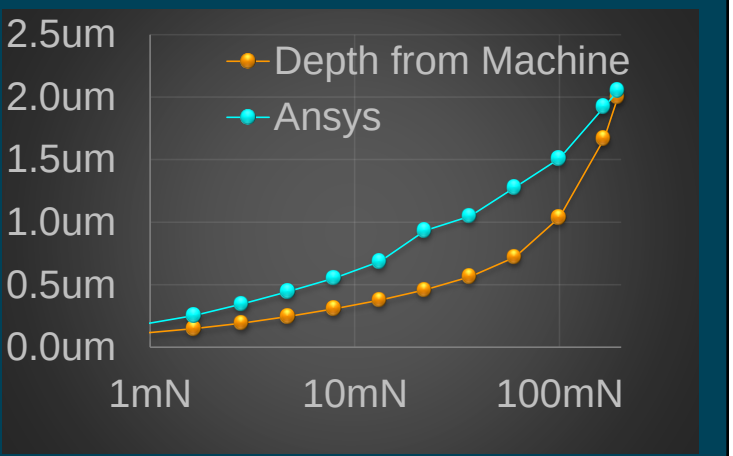
Prediction of Contact Mark for QFN package

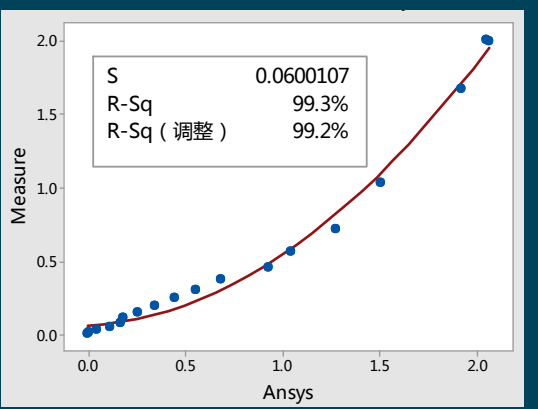
Material Data Correlation

Pad Material : Matt Tin



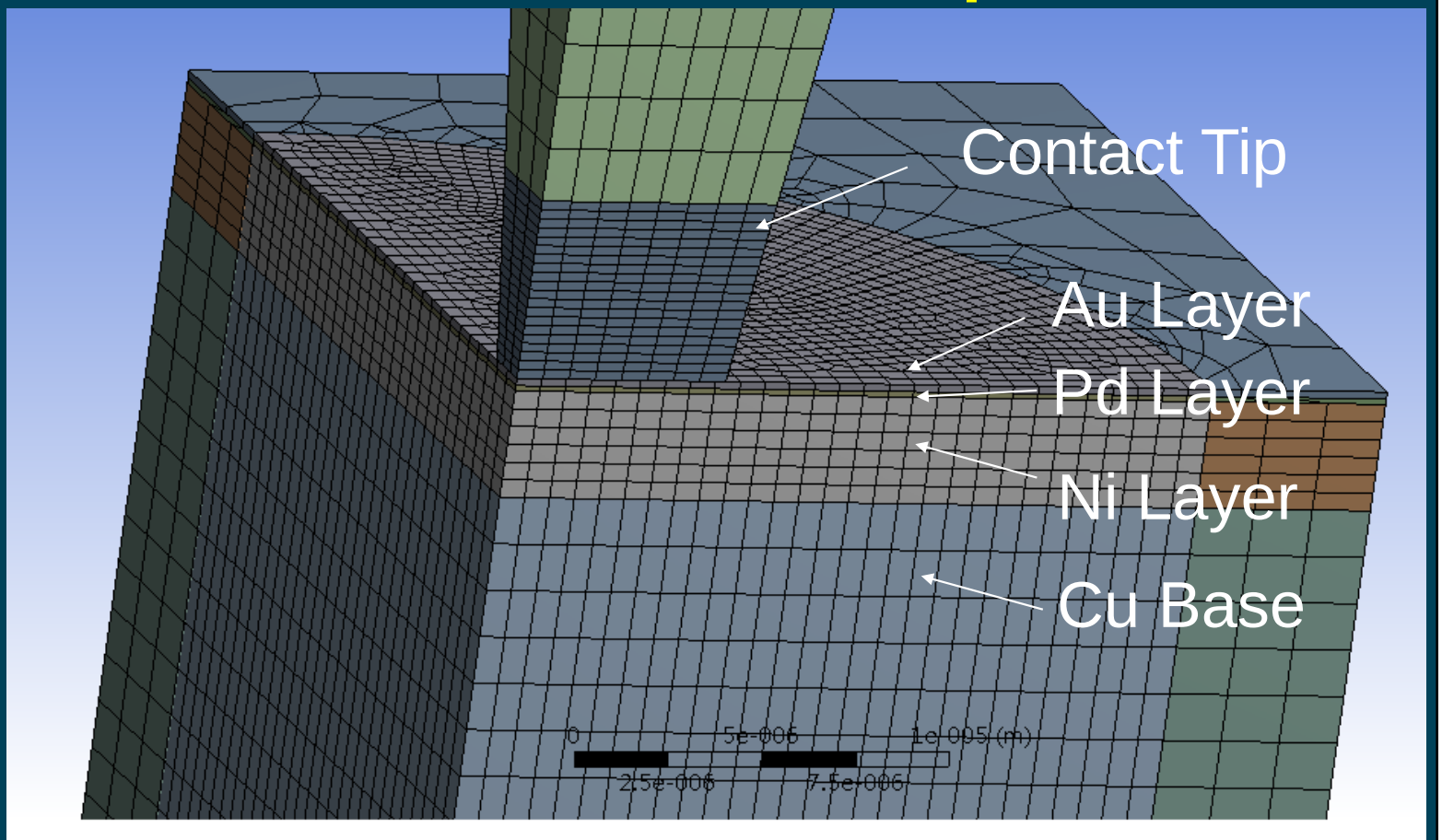
Pad Material : NiPdAu





Prediction of Contact Mark for QFN package

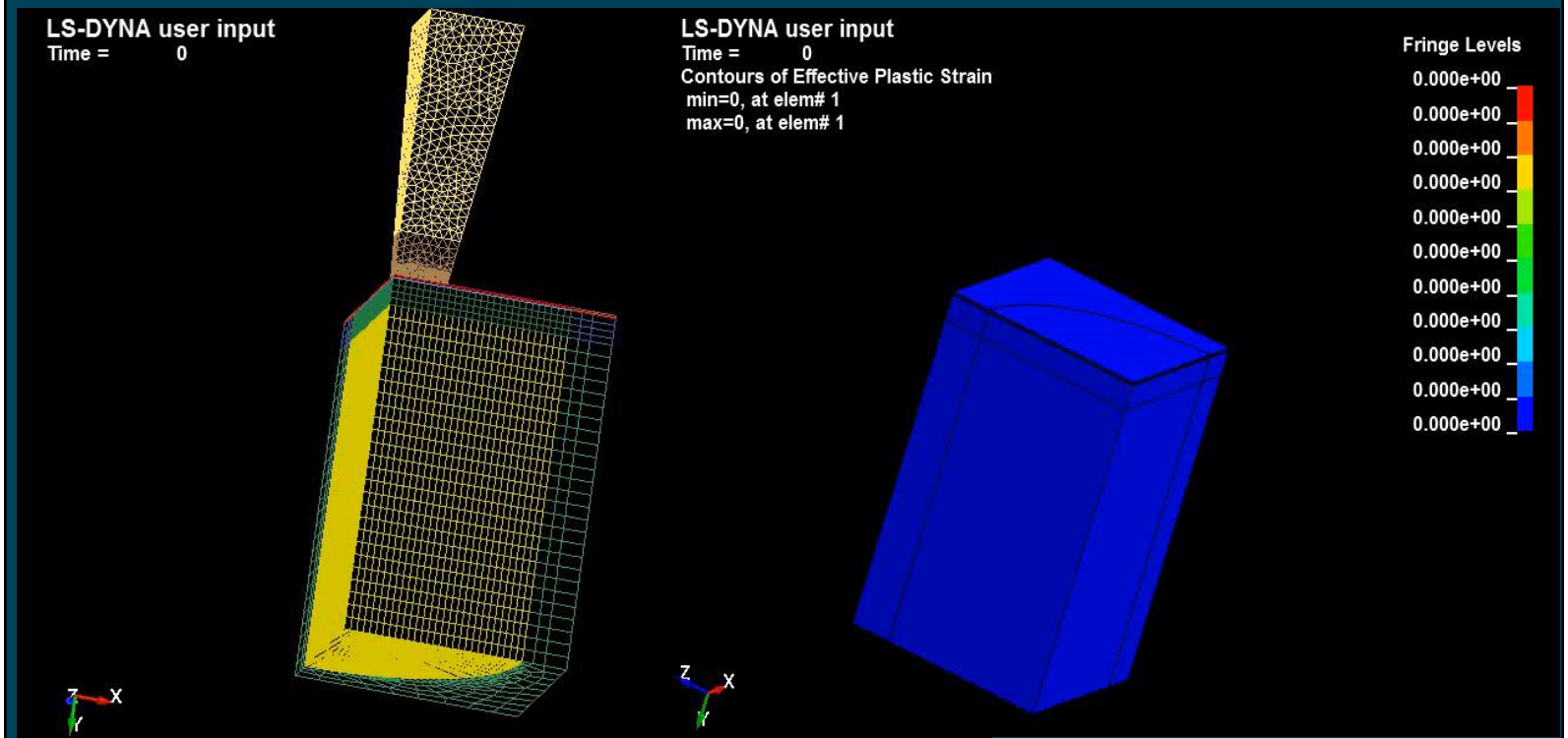
FEA Model Setup



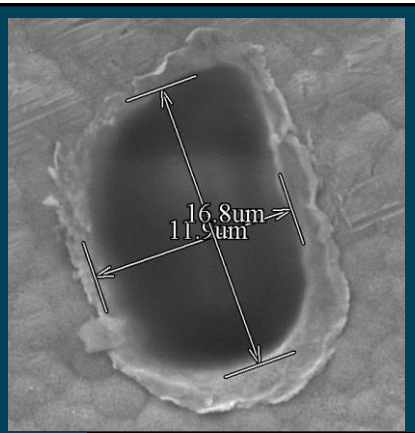
Prediction of Contact Mark for QFN package

FEA Analysis

Pad Material : NiPdAu
Contact Force: 40gf

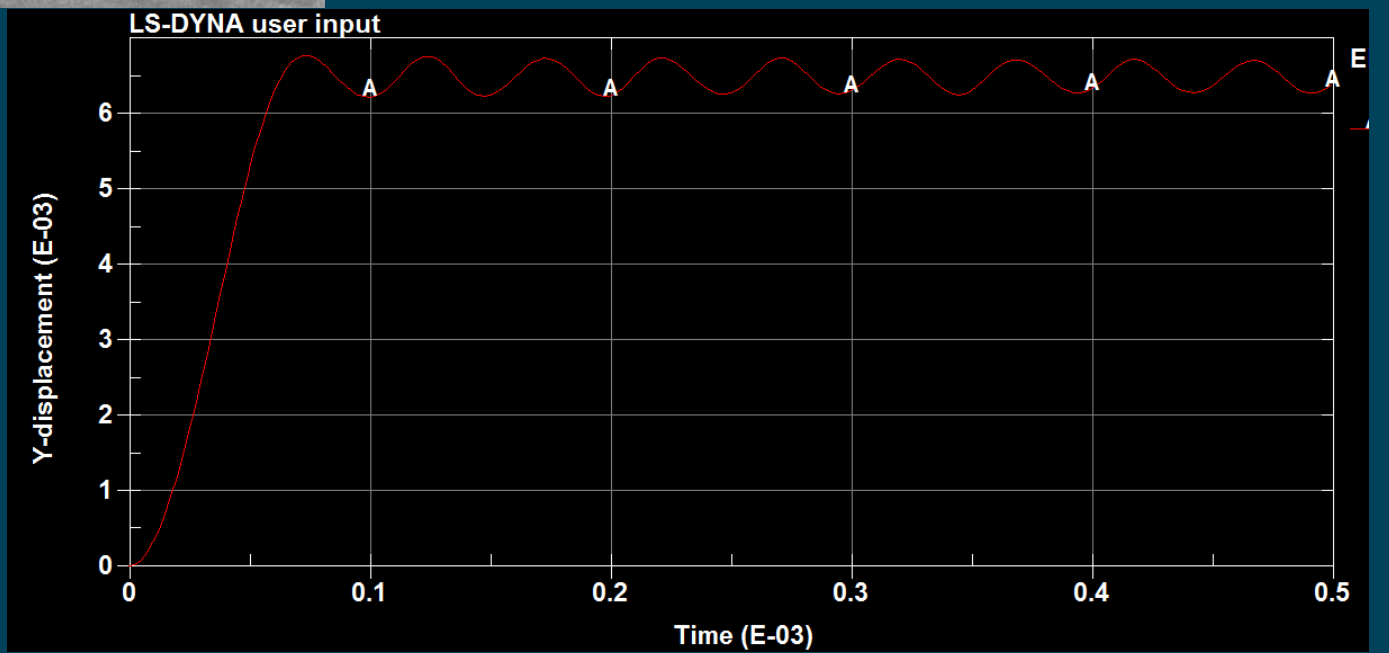


Prediction of Contact Mark for QFN package



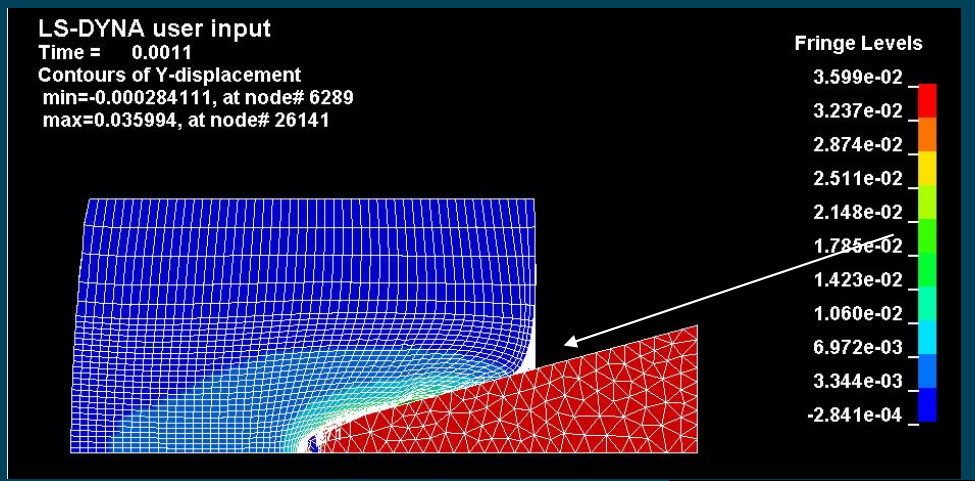
FEA Analysis

Pad Material : NiPdAu
Contact Force: 40gf



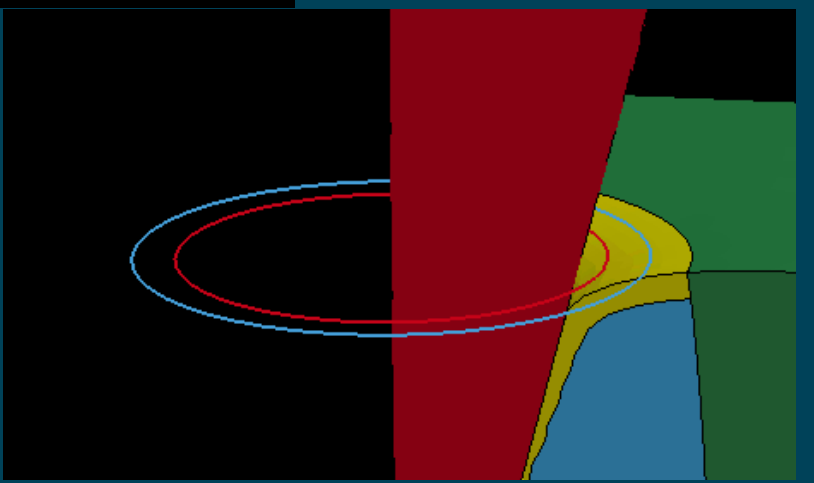
Prediction of Contact Mark for QFN package

FEA Data Vs Measurement

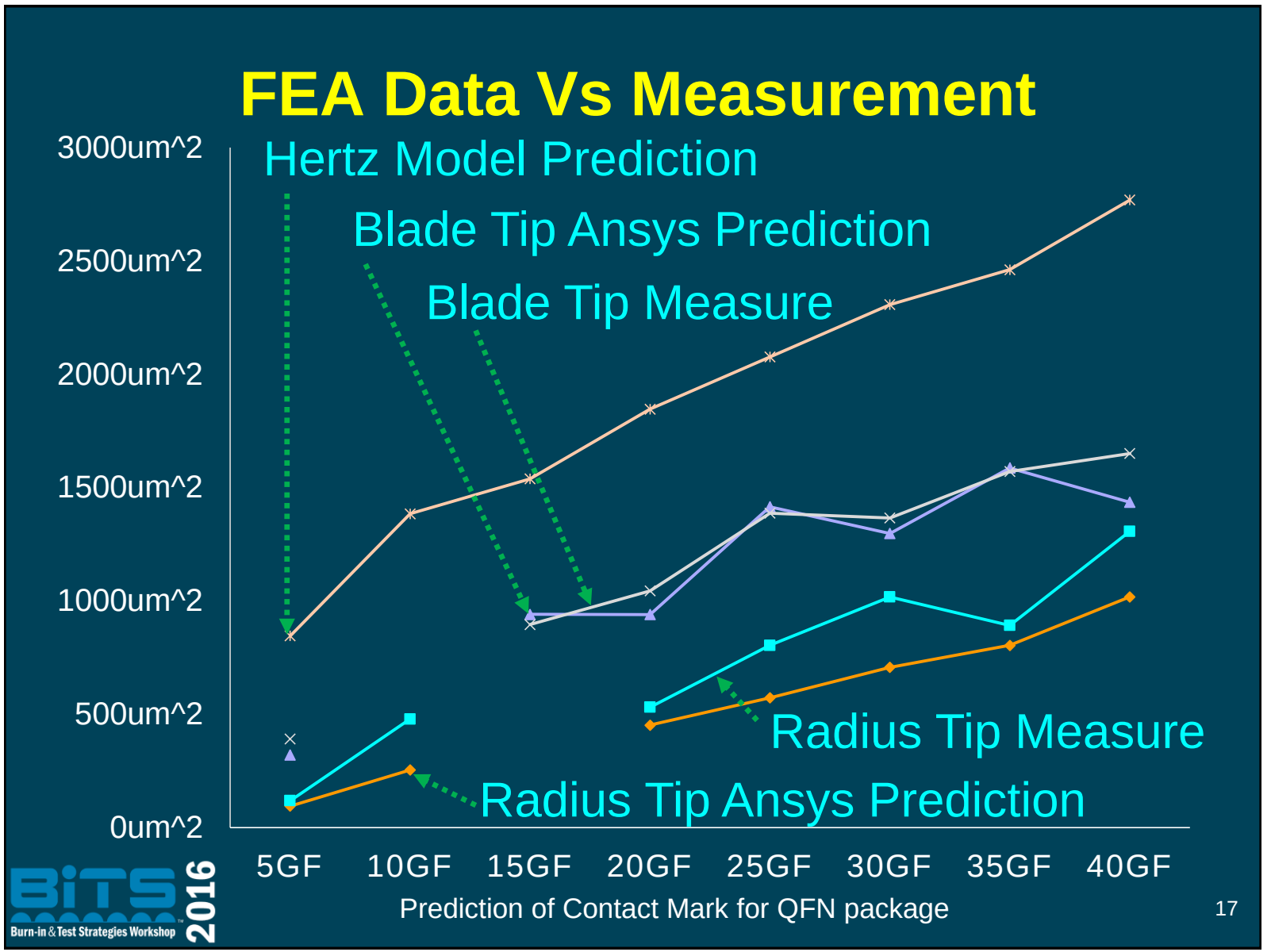


Edge collapse

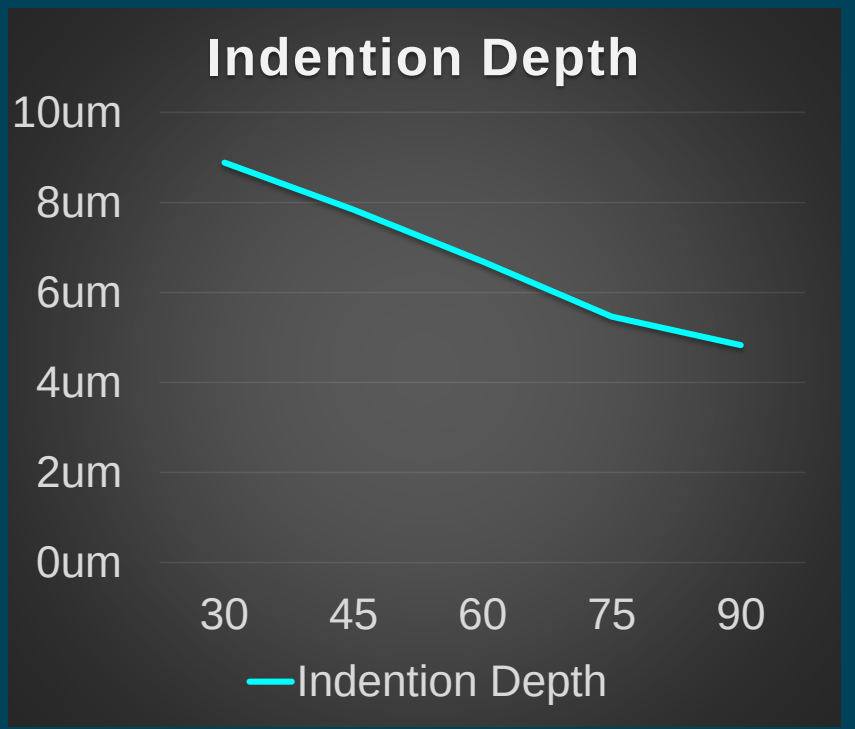
Contact force: 30gf
Tip Diameter: 27.3um
Hole Diameter: 36um



Prediction of Contact Mark for QFN package


FEA Data Vs Measurement
3000um^2
2500um^2
2000um^2
1500um^2
1000um^2
500um^2
0um^2
Hertz Model Prediction
Blade Tip Ansys Prediction
Blade Tip Measure
Radius Tip Measure
Radius Tip Ansys Prediction
5GF
10GF
15GF
20GF
25GF
30GF
35GF
40GF
Prediction of Contact Mark for QFN package

General Prediction-I



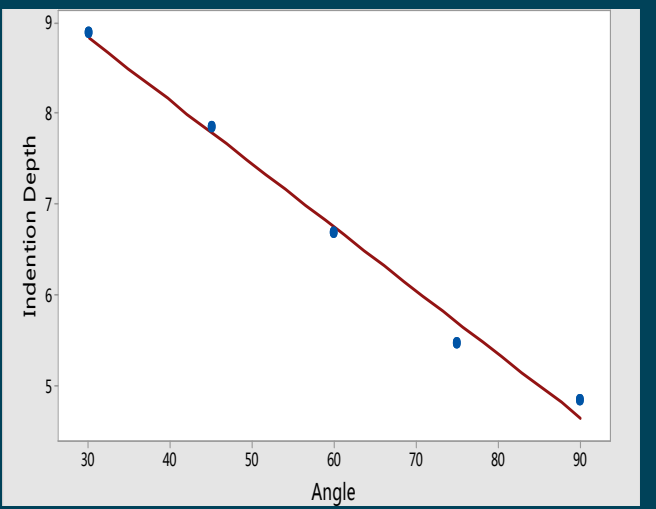
Test Condition:

Contact force: 20gf

Tip Material: Pd alloy

Contact Material: Sn Pad

Tip Radius: R0.015mm



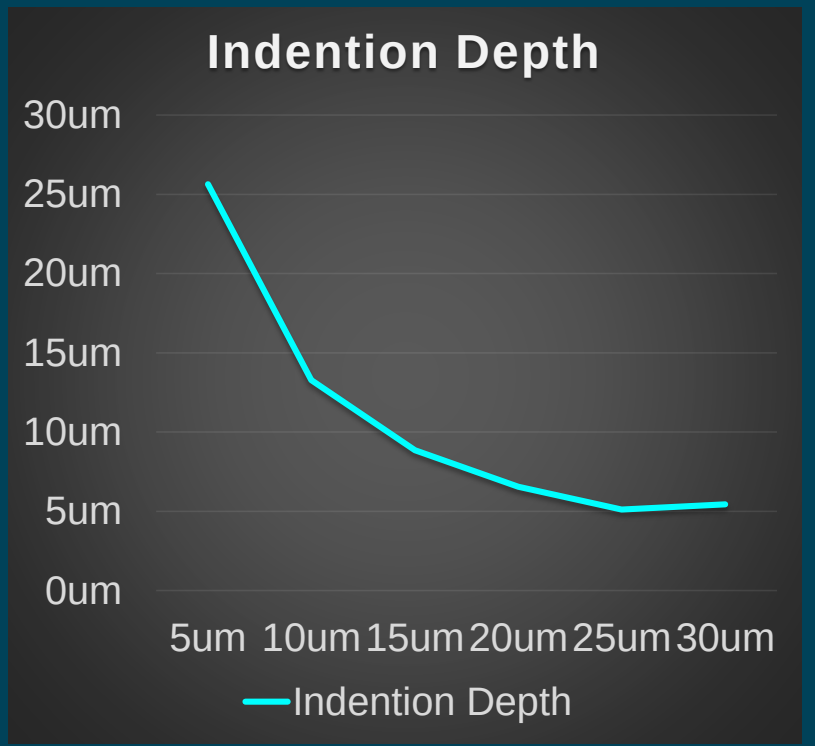
R-Sq = 99.1%

R-Sq(Adjust） = 98.9%

Regression Formula

Indention Depth = 10.94 - 0.07003 Angle

General Prediction-II



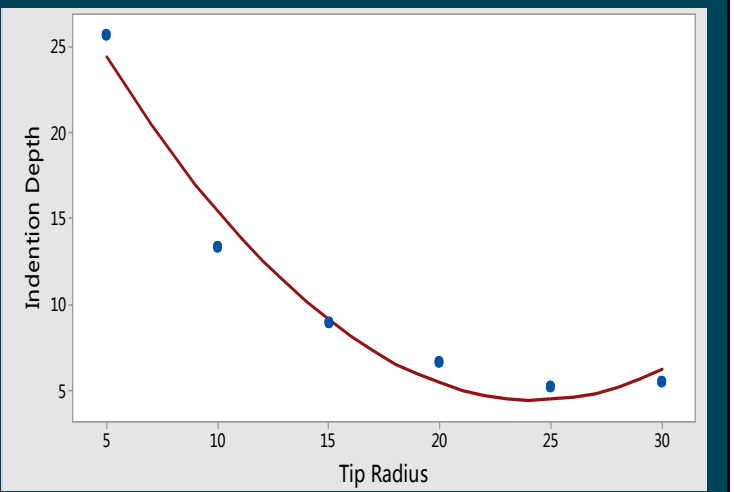
Test Condition:

Contact force: 20gf

Tip Material: Pd alloy

Contact Material: Sn Pad

Tip Angle: 30^0



R-Sq = 97.3%

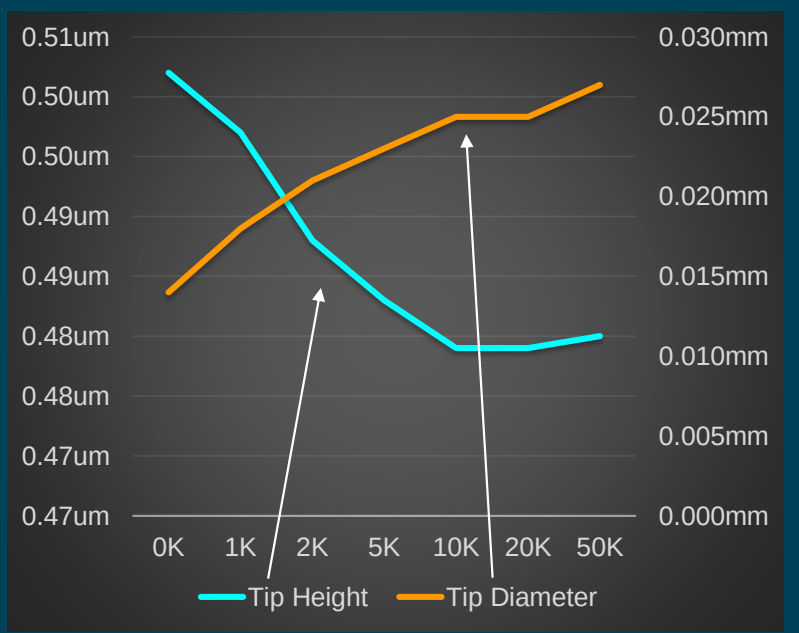
R-Sq（Adjust） = 95.5%

Regression Formula

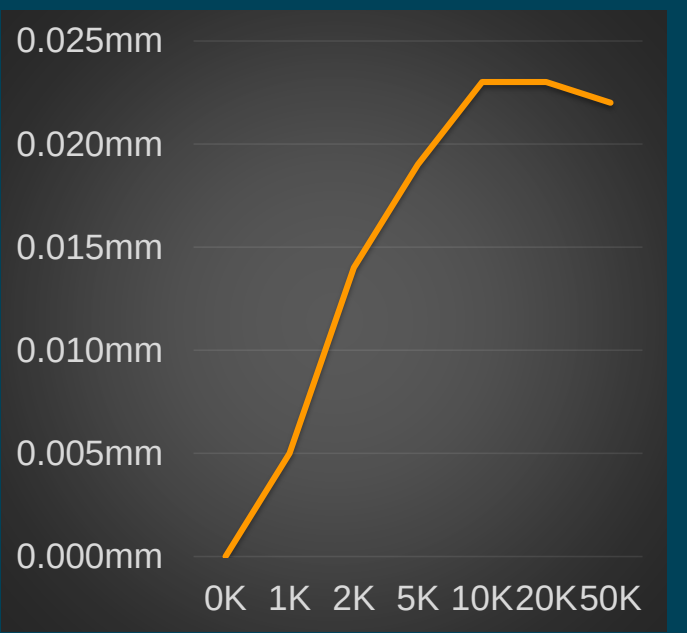
Indention Depth = 36.13 - 2.612 Tip Radius + 0.05378 Tip Radius^2

Wear Out Experiment

Contact Material: Carbon Steel
Tip Material: Pd Alloy
Radius Diameter: 0.014mm
Tip Cutting Angle: 23.9^0

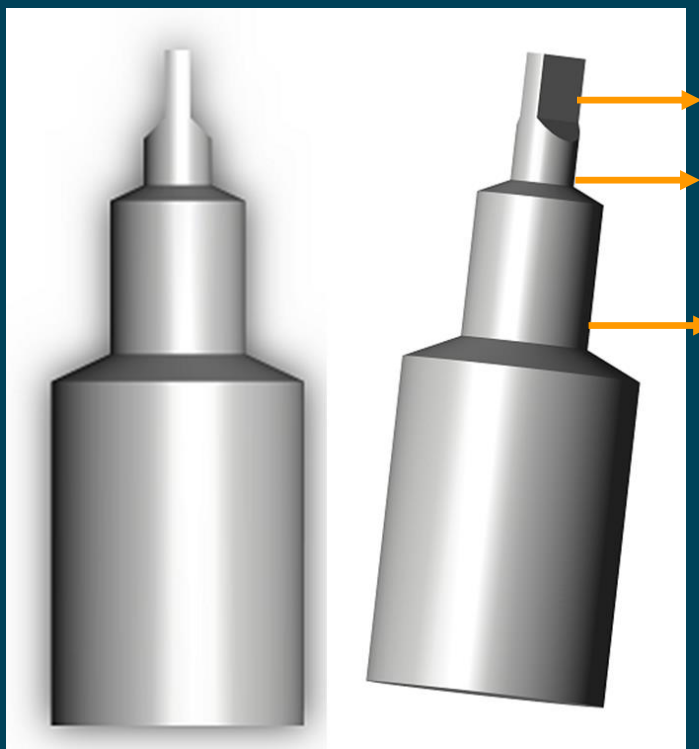


Tip total wear out



Prediction of Contact Mark for QFN package

New Tip Design Concept

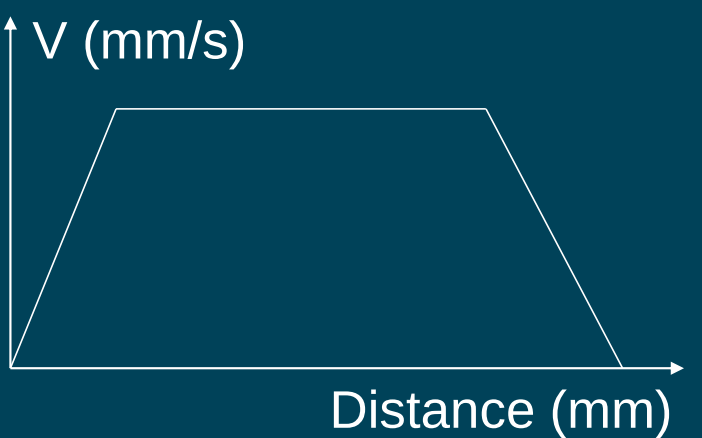


Correlated to different force, by controlling :

1. Compression of spring pin
2. Programing preload

Summary & Further Plan

1. Introduce Nano indenter to get film material data, indention depth vs load, to correlated Young's modulus & stress stain curve.
2. Introduce a way to simulate the contact mark and indention depth as well for QFN package while using vertical spring pin as the contactors.
3. Discussed a new concept of pin tip design.
4. Future plan is going to study the impact to the contact mark by the handler speed.



Prediction of Contact Mark for QFN package