Focusing on a New Challenge within Advanced Vertical Probe Card Guide Plate Drilling

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- Measuring Guide Plate Key Metrics
- Sources of Error
- Solution and Results
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Introduction

Oxford Lasers specialize in the manufacture of advanced vertical guide plates :

Over 20 years experience in guide plate production

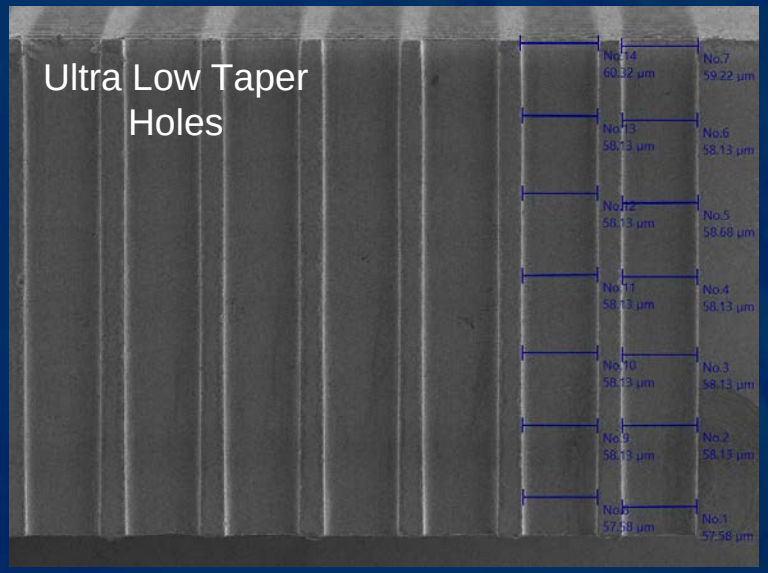
World Class subcontract micromachining facility

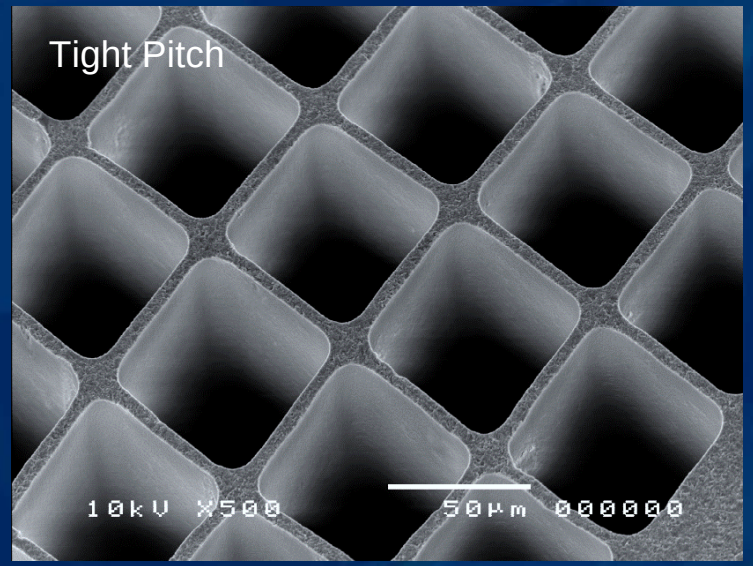
Manufacturer of production laser tools

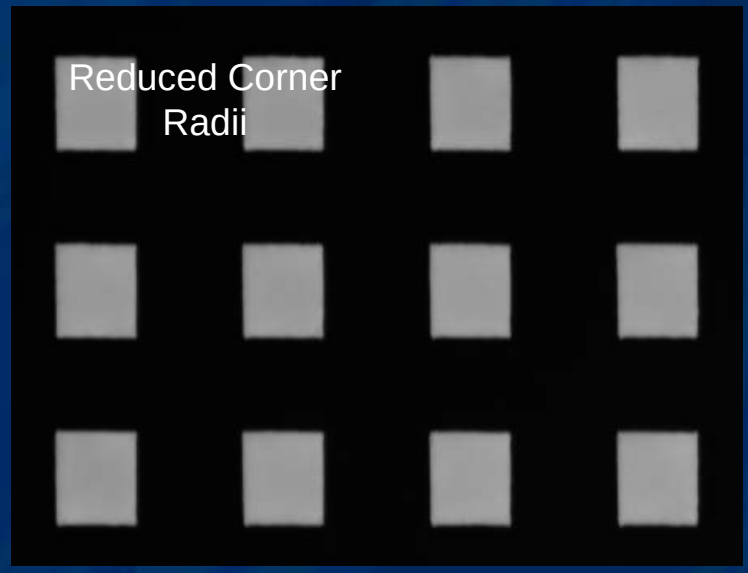
Laser Micromachining :
Ceramics, Polymers, Metals and Glasses

Introduction

Examples of laser micromachining for Wafer Test:







Motivation

Trends in Vertical Probe Cards :

1) **Smaller Holes < 30 microns** ✓
2) **Tighter Pitch < 10 microns between holes** ✓

The focus of this presentation will be the improvement of guide plates for advanced Probe Cards :

In particular the need for improved positional accuracy

Position Error Improvement

What are we trying to improve ?

Here we are looking to improve the error in the position of the drilled micro holes when their actual position is compared to drawing.

This position error can be :

a) Relative to alignment holes on the guide plate itself or

b) Relative to the individual micro holes themselves

Current Requirements : < 3 microns

Future Requirements : < 1 micron

Sources of Error

1) Drilling Tool : thermal stability of mechanical design

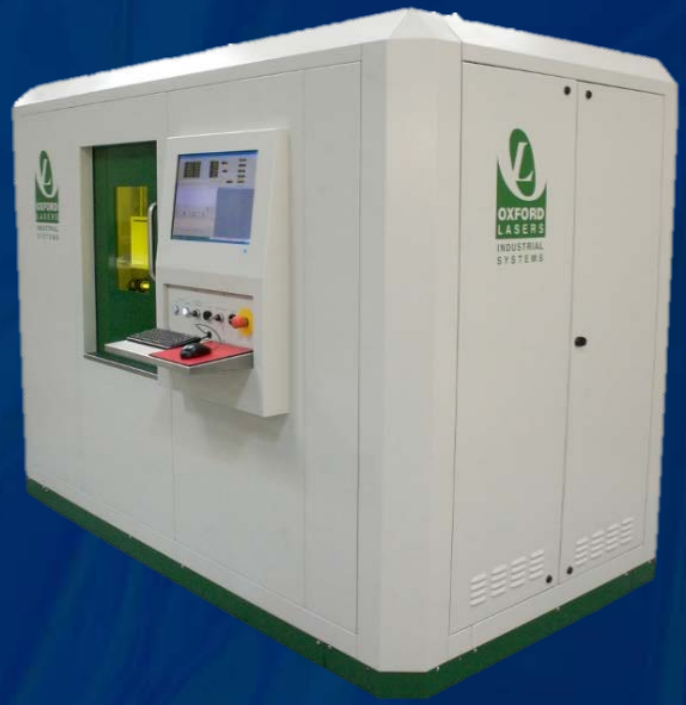
2) Temperature : stability of room temperature

3) Laser Source : pointing stability

4) Motion Control : stage accuracy

5) Calibration : calibration of the laser drilling tool

6) Calibration : calibration of the measurement tool



Types of Error

1) Random Errors

Example : Repeatability Errors :- Ensuring any motion system(s) return to the same point in space (i.e. bidirectional repeatability)

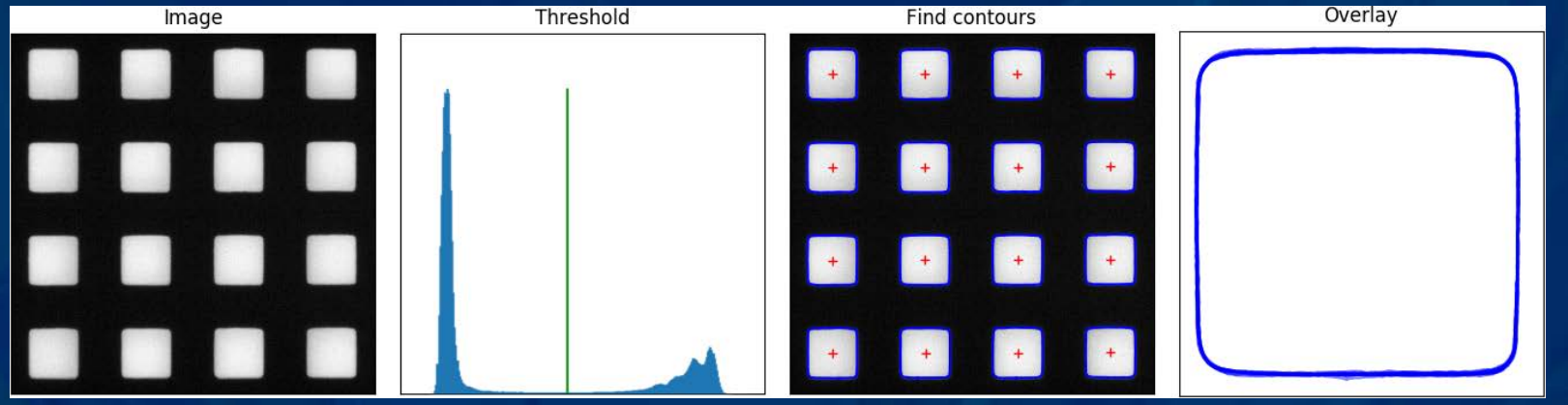
Note : This type of error cannot be compensated nor calibrated for, as its not predictable

2) Systematic Errors

a) Linear Errors : Example - Thermal expansion effects

b) Non-linear Errors : Errors that do not follow a straight line as you traverse the guide plate

Measuring Key Metrics



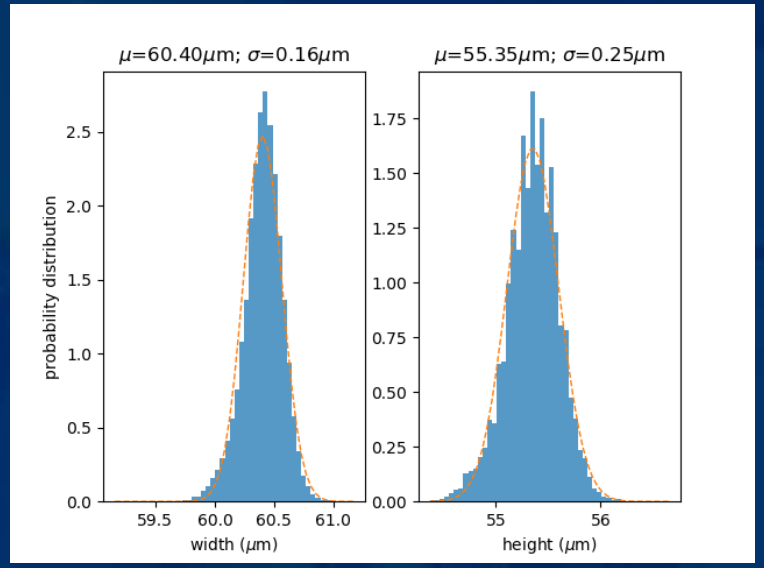
Capturing Holes | Thresholding | Locating Centroids | Contour Plots

Measuring key metrics for every hole – informs tool maintenance

Metrics to measure, size, position, corner radii, taper

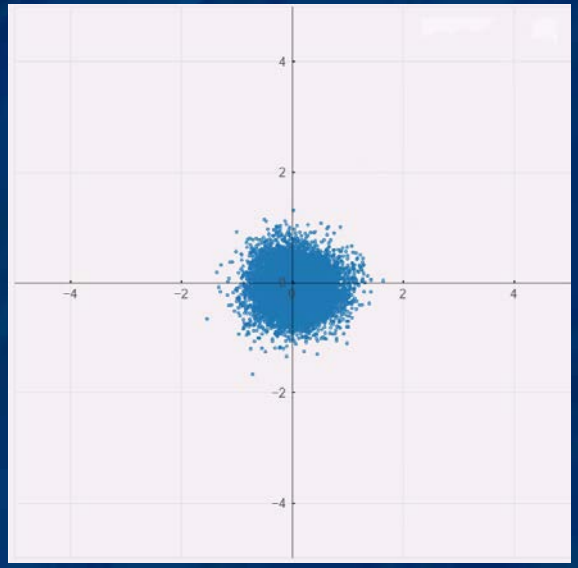
(See presentation given at SW Test 2017 for more detail on the above)

Measuring Key Metrics



Hole Size

(< 0.3 microns)



Position Error

(< 3 microns)

Solution

Through proprietary software which has been developed over many years – we have been able to improve positional accuracy

Continuously monitor positional data across multiple guide plate designs, 24/7, across all manufacturing tools

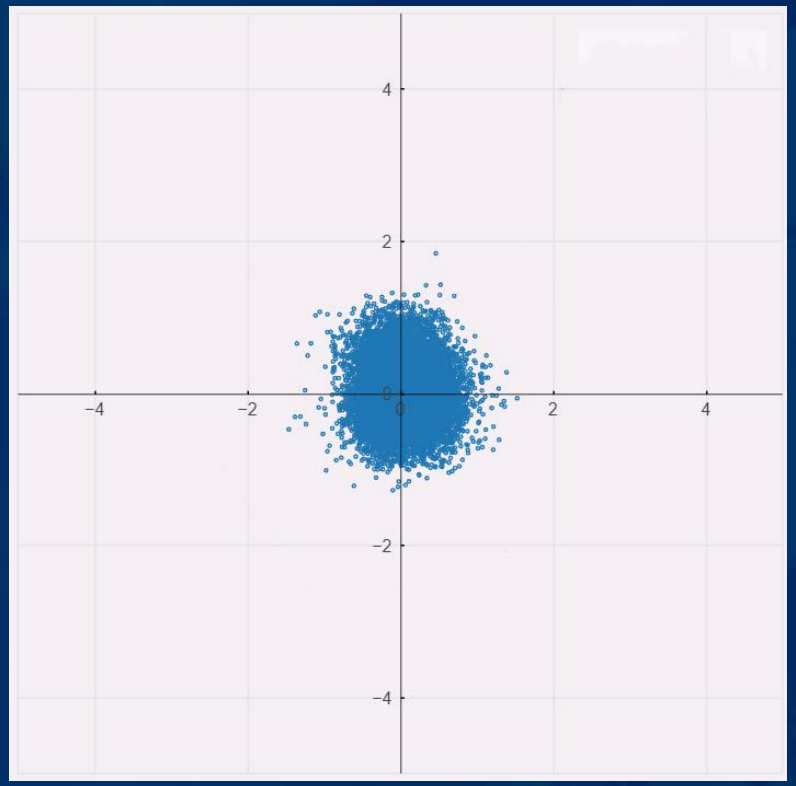
Analyse position errors for a) random and b) systematic error forms

Update hardware to correct for position errors

Feed the resultant data back into the tools to allow correction of hole position

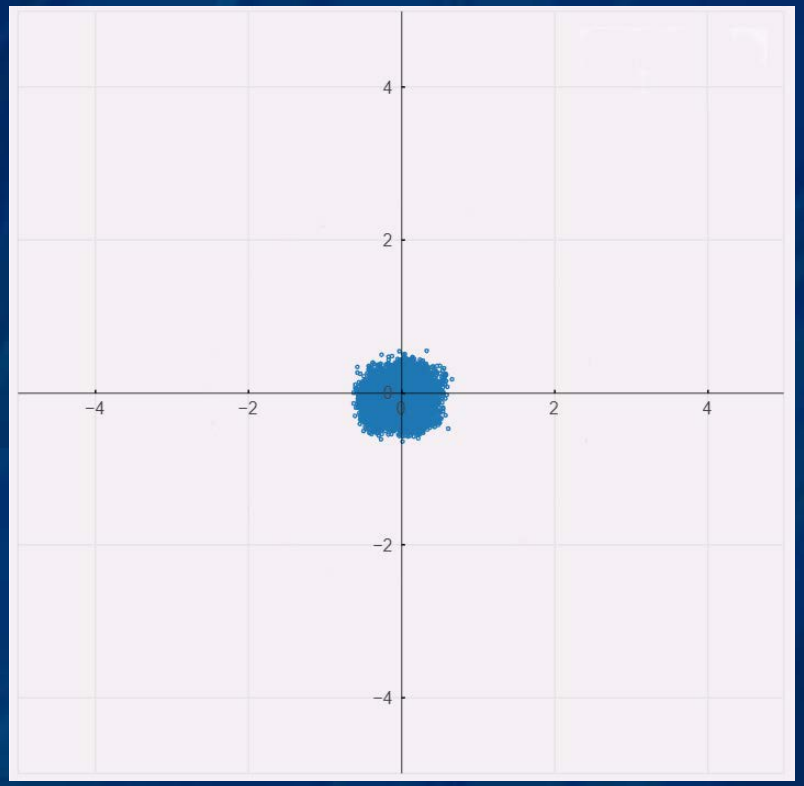
Results

Before



Less than 3 microns error

After



Less than 1 micron error

Summary

1) It has been shown that it is possible to improve micro hole positional errors to below one micron

2) This will enable the probe card designer to better control the probe needles, this being particularly important as probe pad or bump size reduces

Follow on Work

1) Monitor the improvements longer term to identify any other sources of error

2) Implement these new techniques into production guide plates

Thankyou

My thanks for this work go to :

From Oxford Lasers :

Simon Tuohy
Etienne Pelletier
Dimitris Karnakis
Mike Gaukroger

Thank you for your Attention