SWTEST

PROBE TODAY, FOR TOMORROW

2023 CONFERENCE

Overcoming New Challenges in Advanced Vertical Probe Card Guide Plate Drilling

OXFORD LASERS

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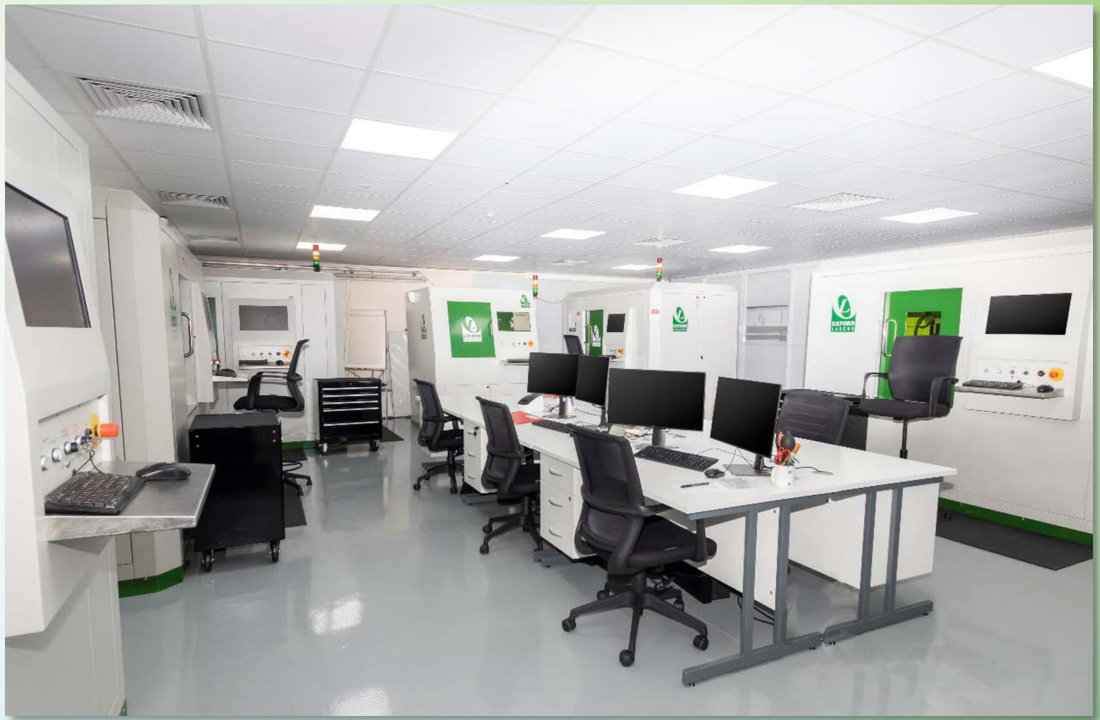
Overview

- Introduction
- Motivation
- Laser Drilling Methods
- Tighter Pitch
- Thicker Materials
- Summary
- Follow-On Work

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

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 Thicker Materials
  (higher aspect ratios / lower corner radii)

Towards Thicker Materials

Reasons to use thicker materials :

There is a trend for guide plate designers to build probe heads from thicker materials for a number of reasons namely :

a) ease of manufacture of the probe head

b) better control of the probe in contact with the test pad and

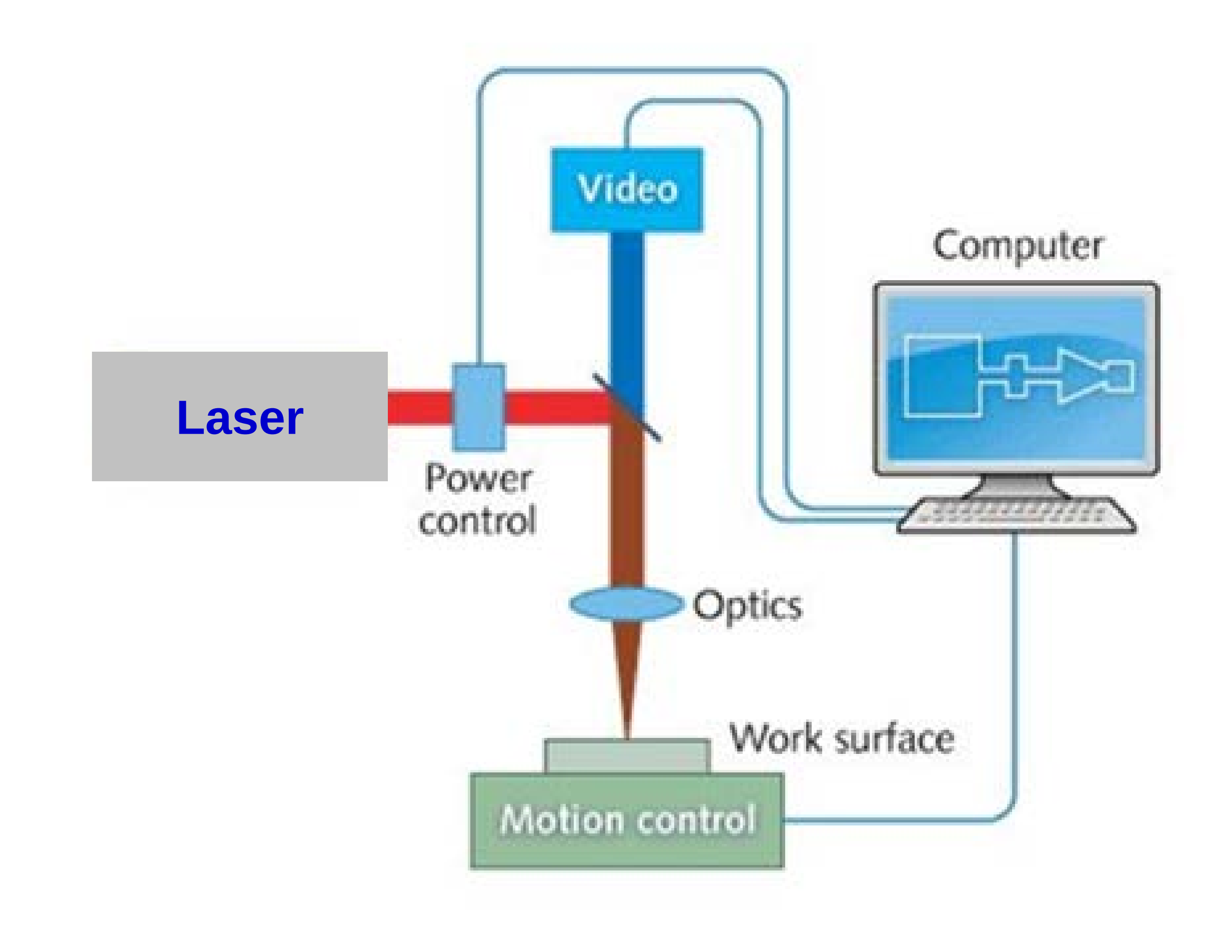
c) a more rigid guide plate avoiding plate flexure

At the same time ensure excellent hole quality, low corner radii, tight pitch

Laser Drilling Methods

Direct Laser Write:-

- Direct-write, maskless process
- Non-contact
- Optical resolution (diffraction limited)
- Can produce <u>ANY</u> feature geometry on <u>virtually any</u> material surface



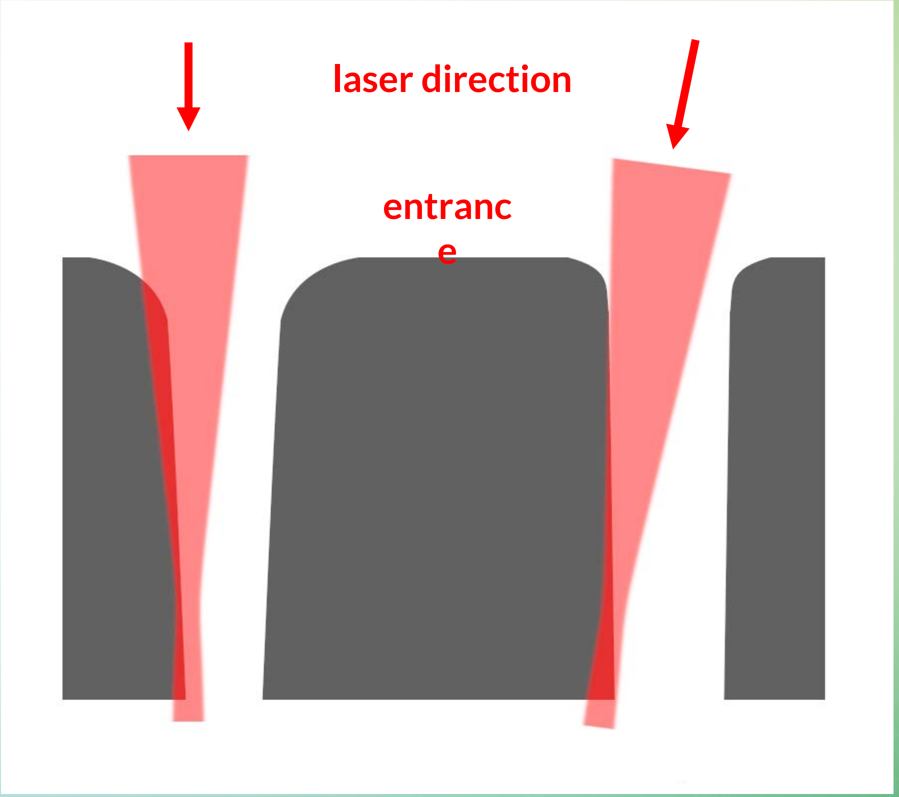
Laser Drilling Methods

Drilling techniques -

Two Axes or Multi Axes Drilling:

Here the beam is moved relative to the material. This can for example allow a combination of

a) piercing
b) spiralling
c) polishing



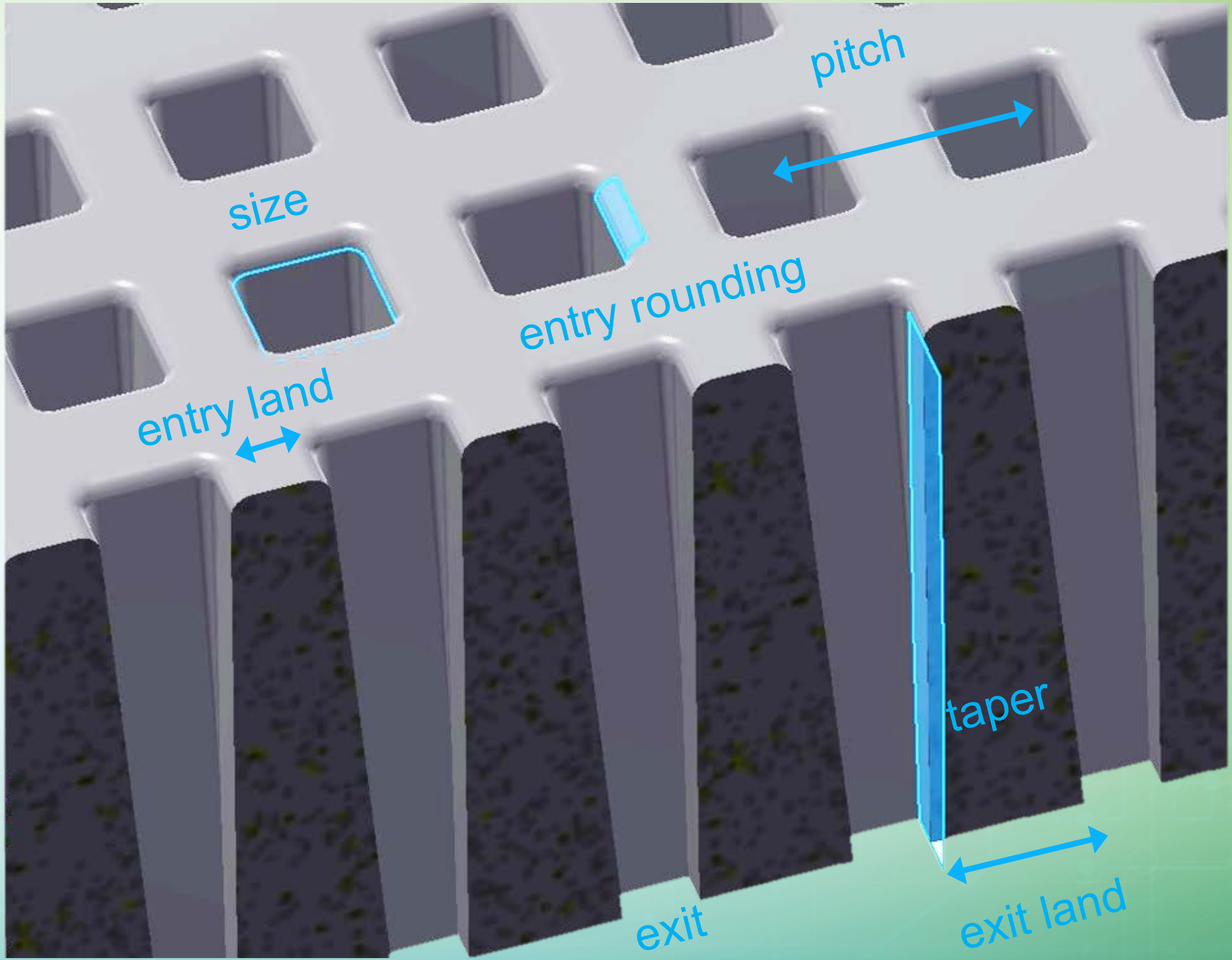
This results in excellent and controllable hole quality

Importance of Metrology

We need to carefully define :

a) Taper

b) Corner radii



Difficulties in Measurement of Corner Radii

- Hole dimensions, taper and position are easier to measure
- Corner radius and entry rounding are extremely challenging

Many different methods can be used to measure corner radii :

Software fitting of corner radius is better than operator fitting

<u>But which is the best method/algorithm to use ?</u>

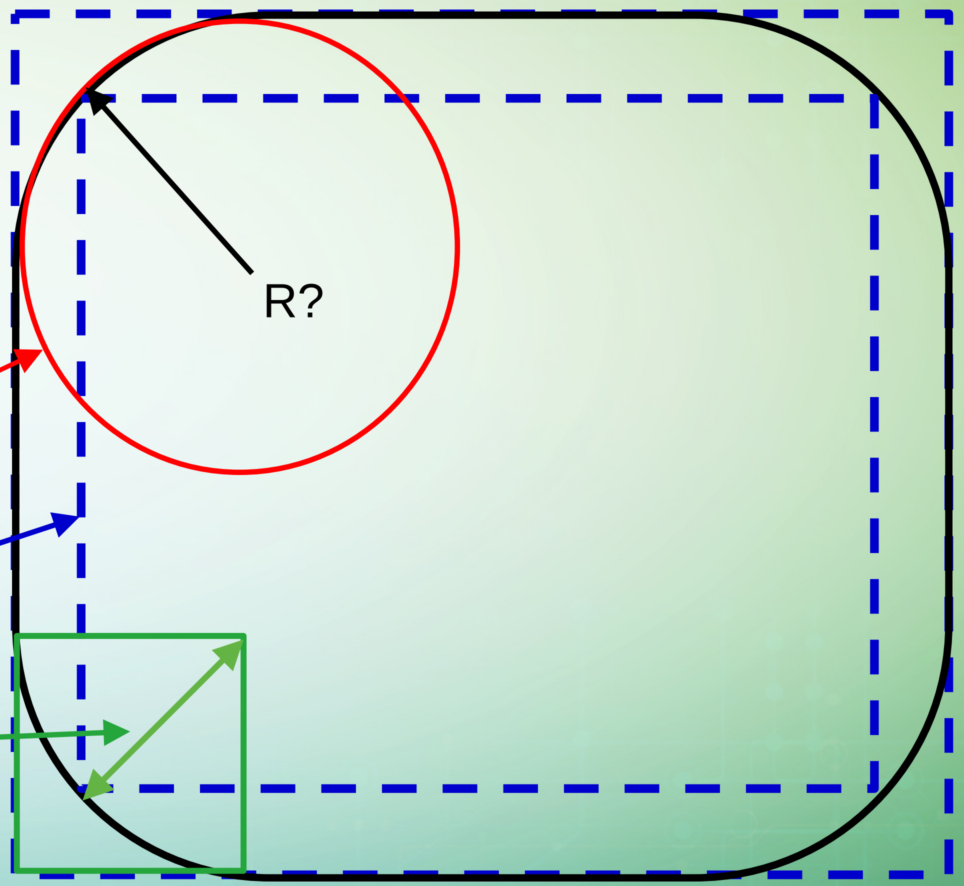
1. Select a number of points and fit to a circle

2. Relationship between largest inscribed square and smallest out-scribed square

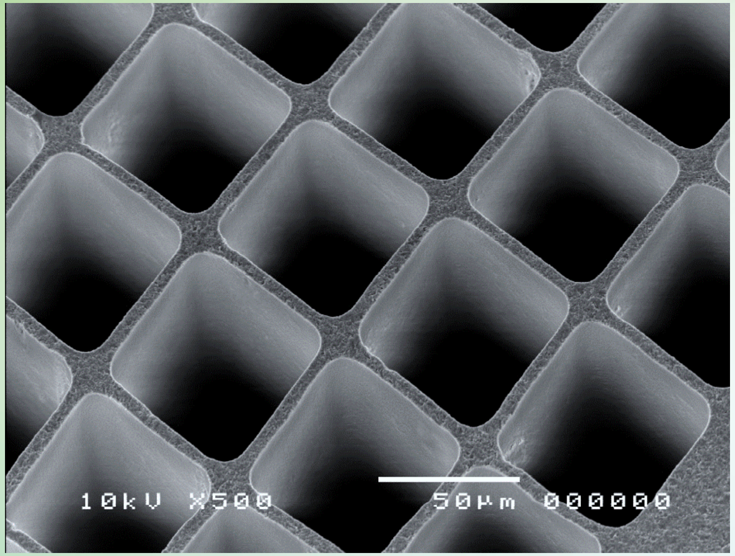
3. Measure distance at 45 deg.

These methods rely on arbitrary assumptions:

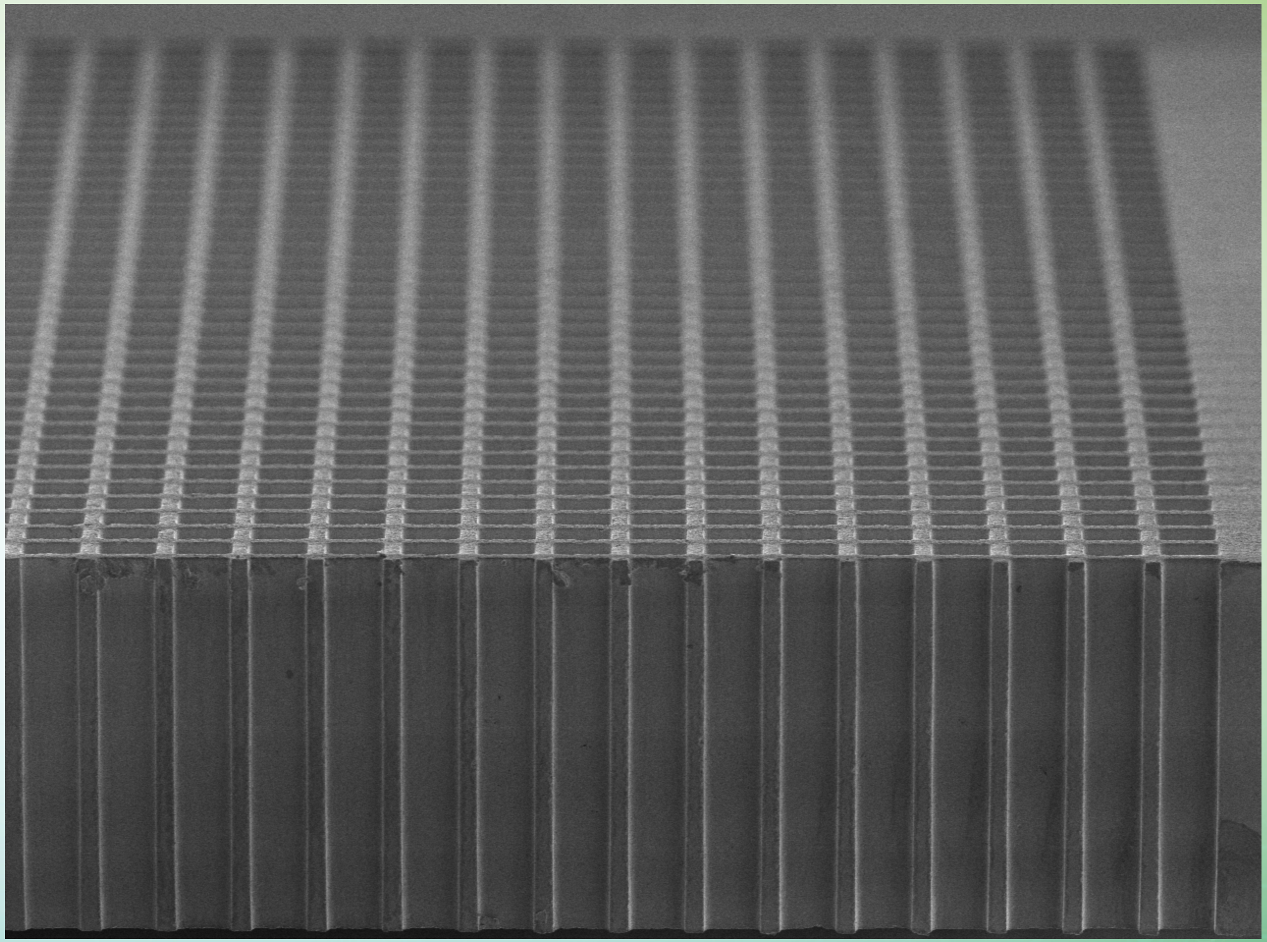
So care needs to be taken !



Tighter Pitch



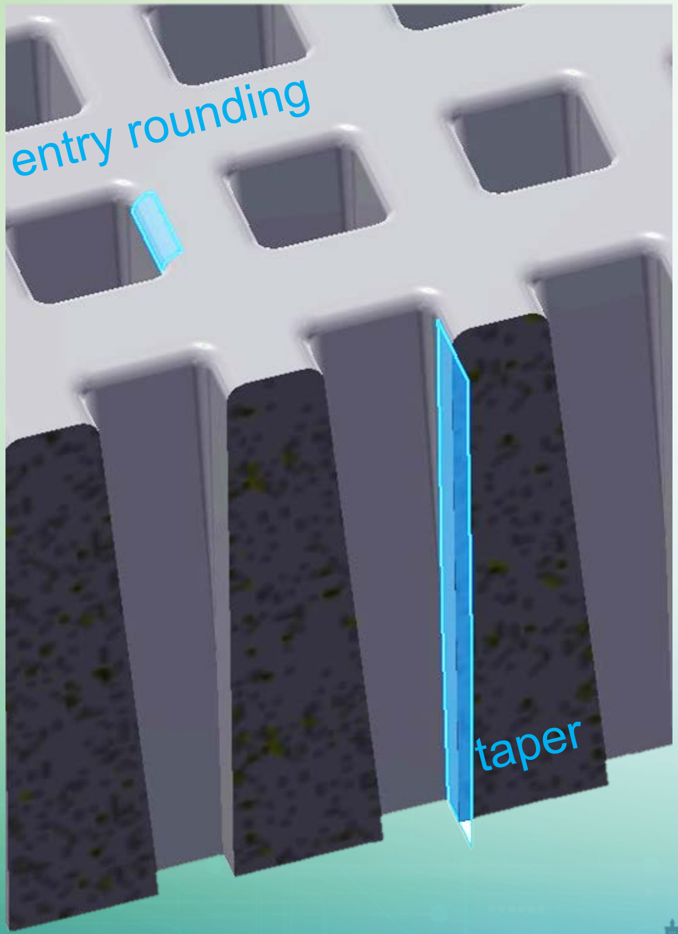
6 microns webbing between holes

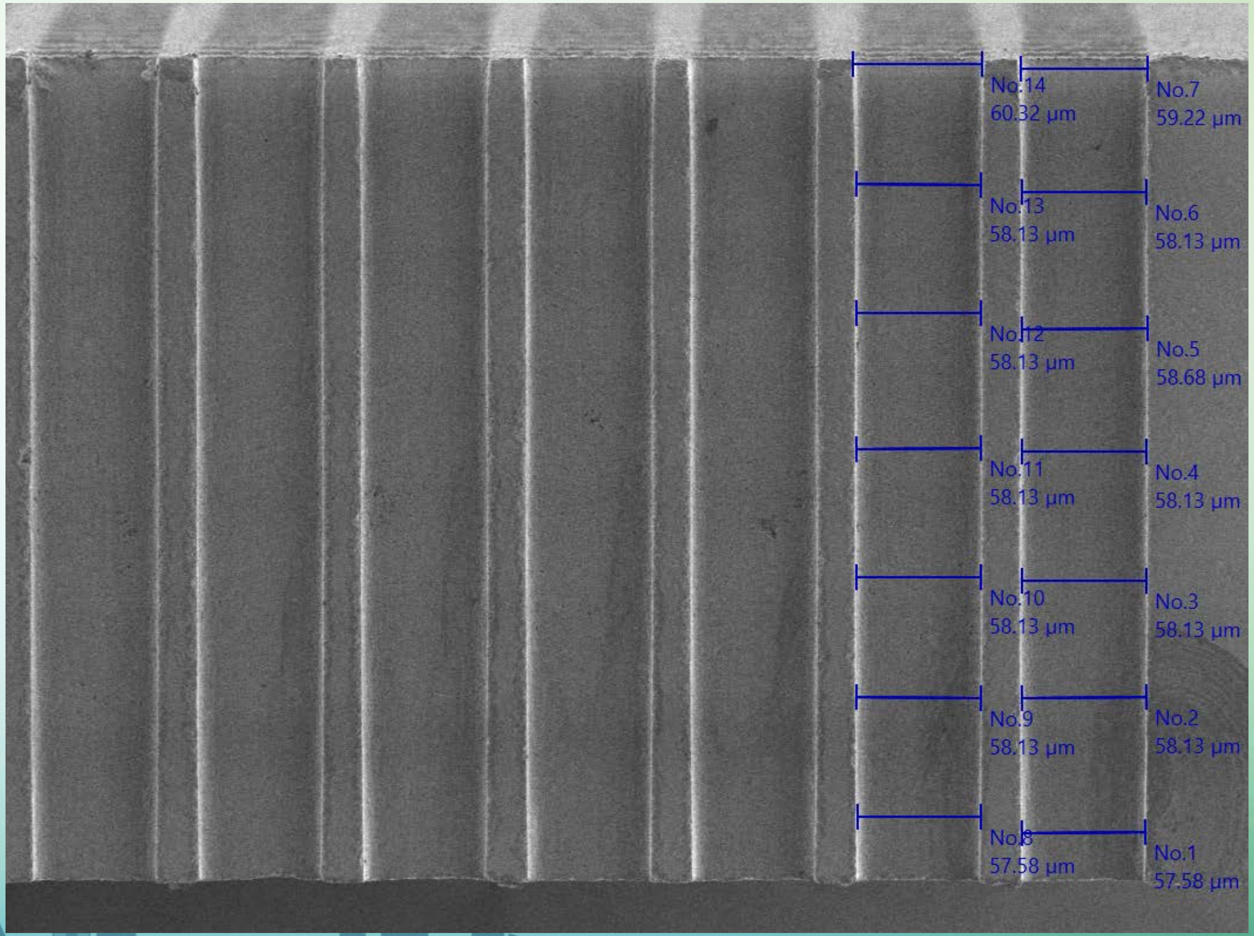


Ultra Low Taper

Towards Even Tighter Pitch

Definition of taper :



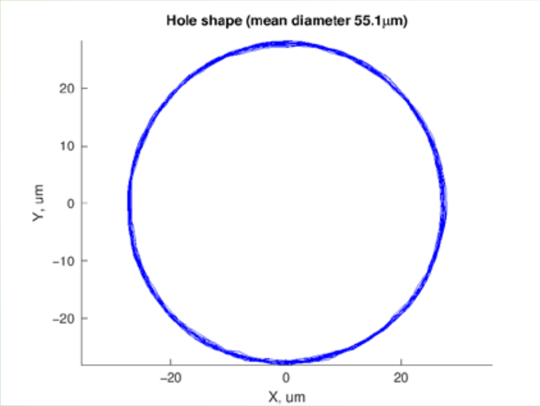


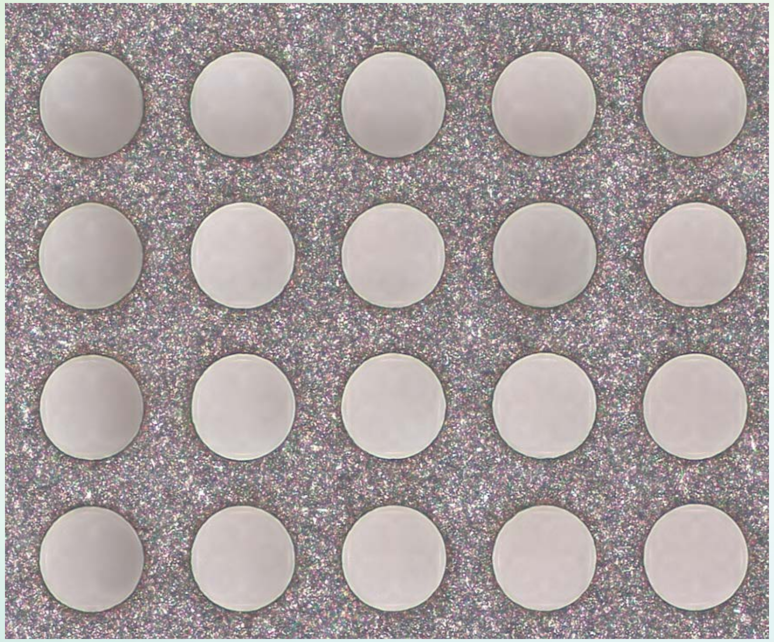
60 microns

Taper = 2 microns

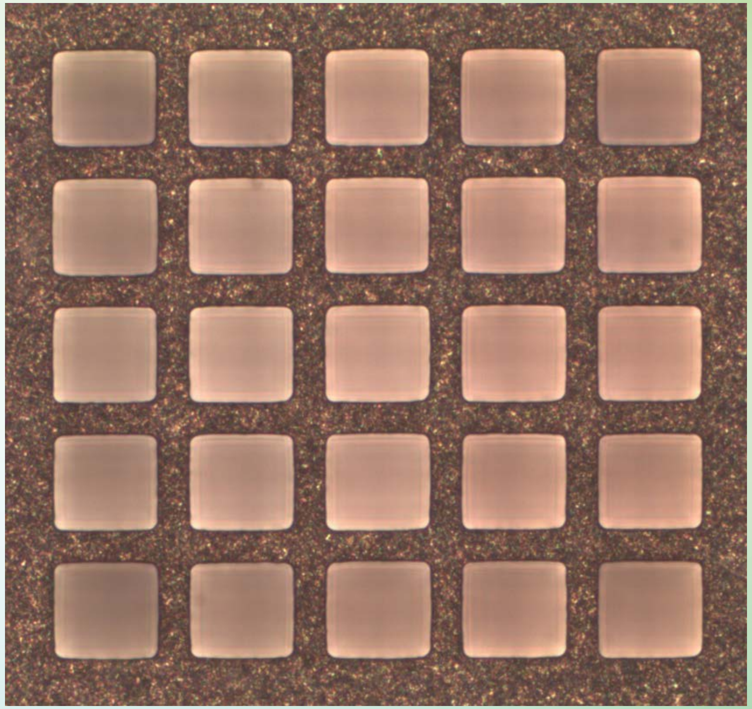
58 microns

Thicker Materials





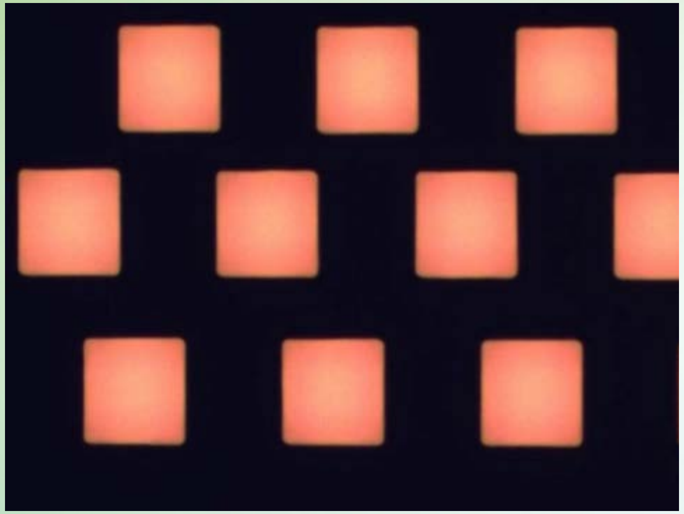
19 mil - 480 microns thick Silicon Nitride

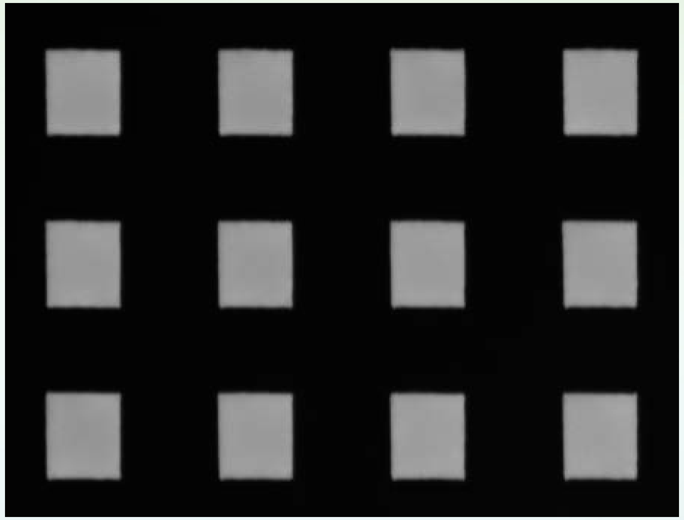


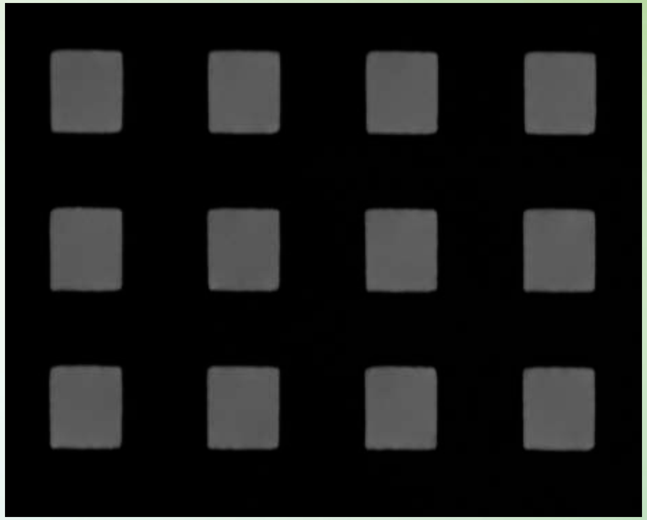
18 mil – 460 microns thick Silicon Nitride

Examples of square and circular holes

Corner Radii and Thicker Guide Plates

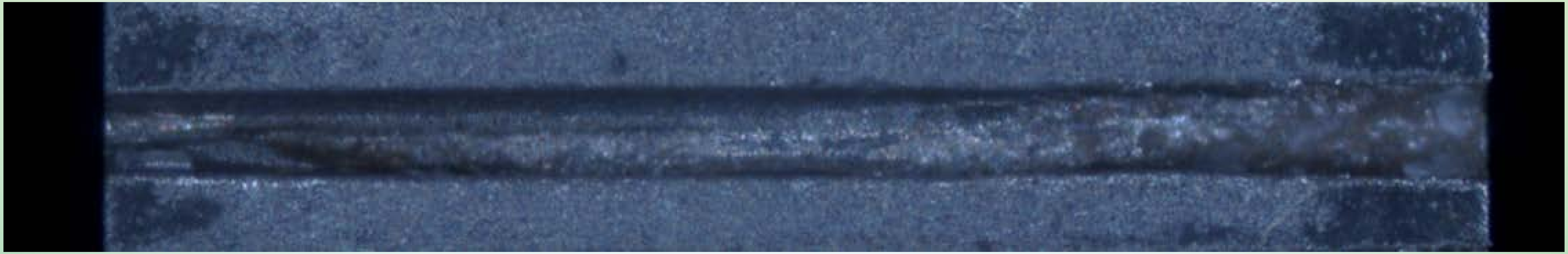






Corner Radii :		
< 2 microns	< 3 microns	< 5 microns
Thickness :		
5 mil – 127 microns	10 mil – 254 microns	15 mil – 380 microns

Even Thicker Guide Plates !



1.2mm Thick Silicon Nitride

Summary

- It has been shown that drilling high aspect ratio holes in thicker materials is possible.
- This paves the way for probe card engineers to use more robust designs.
- Corner Radii : While increasing with material thickness, this can be controlled and reduced with the correct drilling strategy

Follow-On Work

- Continue to drive down Corner Radii on thicker materials
- Investigate rectangular hole drilling in yet thicker materials
- Push these new techniques into production

Thankyou

My thanks for this work go to :

From Oxford Lasers :

Simon Tuohy
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Dimitris Karnakis
Mike Gaukroger

Thank you for your Attention