Practical ultrafast laser micromachining:

Bill Clark
Clark-MXR, Inc.

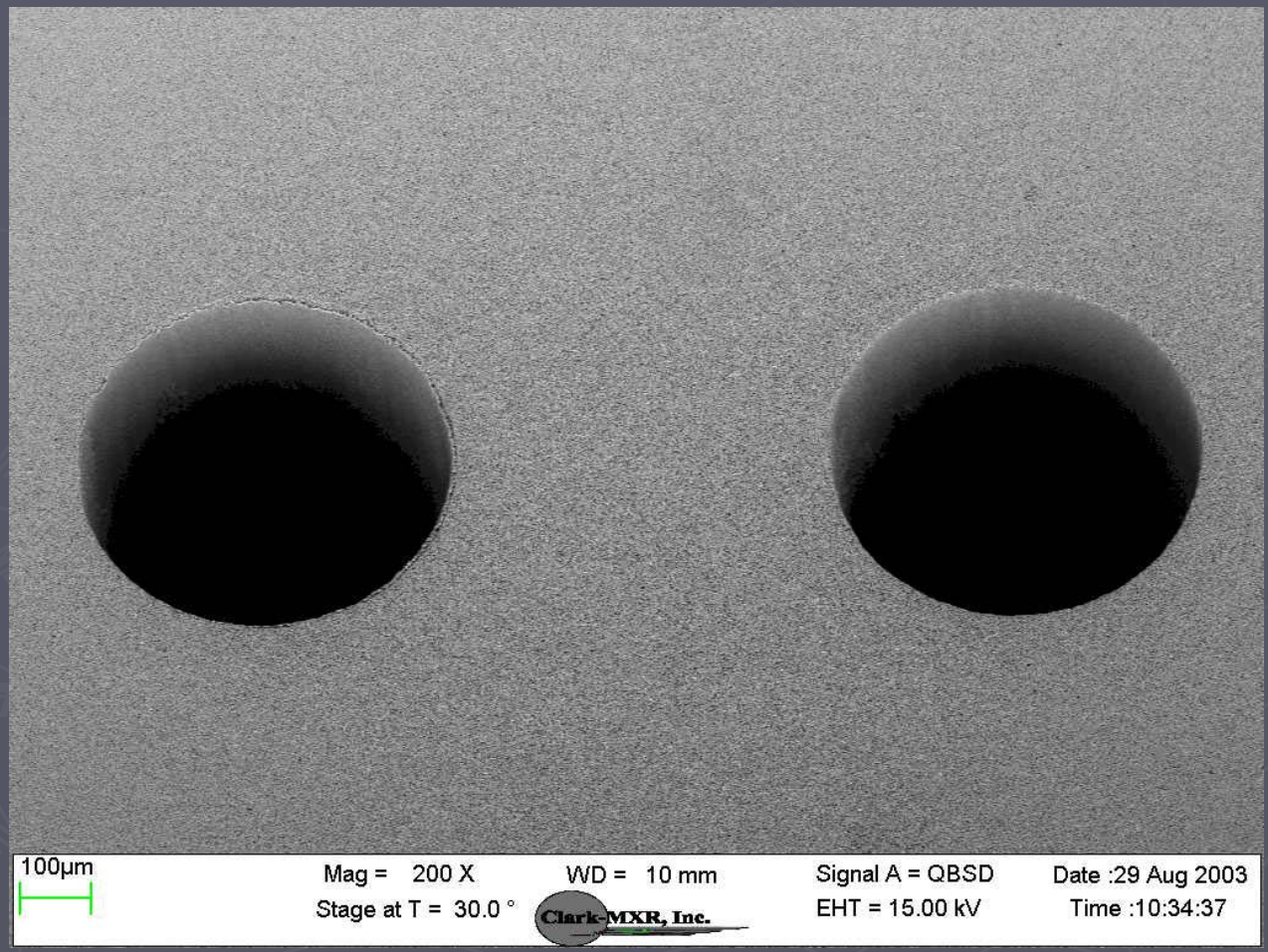
Overview:

- What's the fuss about?
- What can be done
  - Current Applications
  - Future Applications
- Where is this all going?
- Can ultrafast solve my problem?

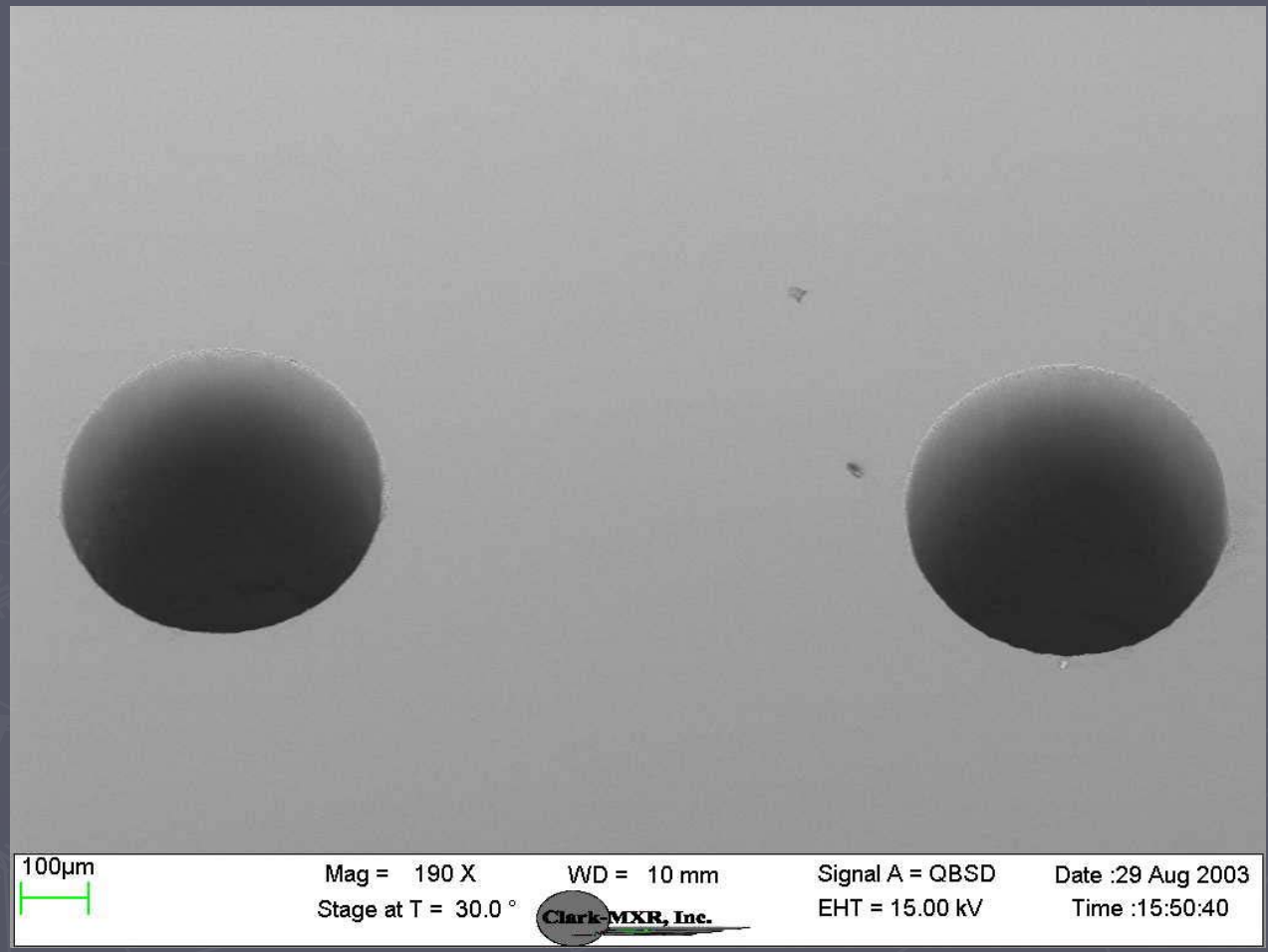
What is all the fuss about?

Examples from our archives

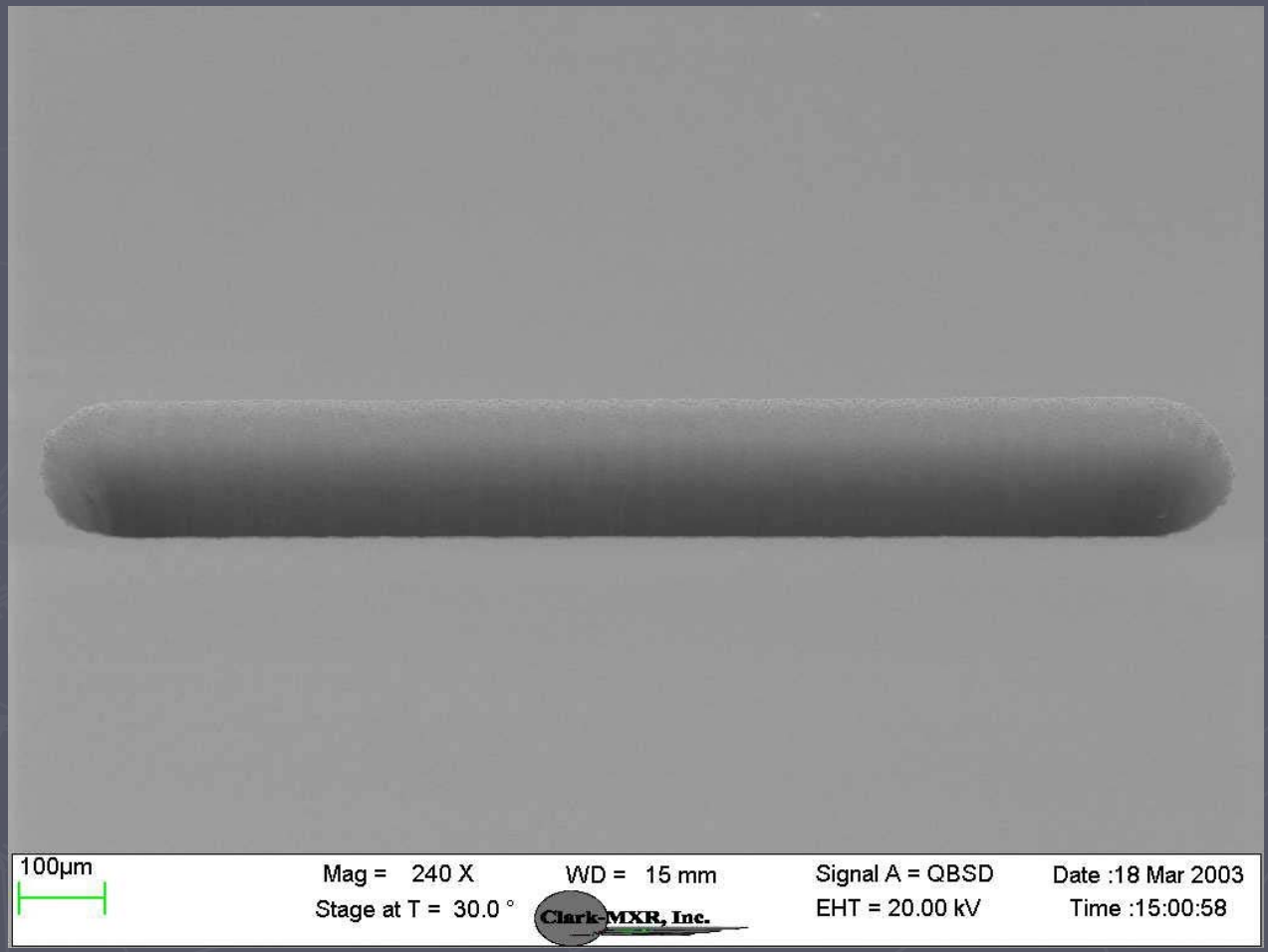
400 µ Ø holes in ceramic



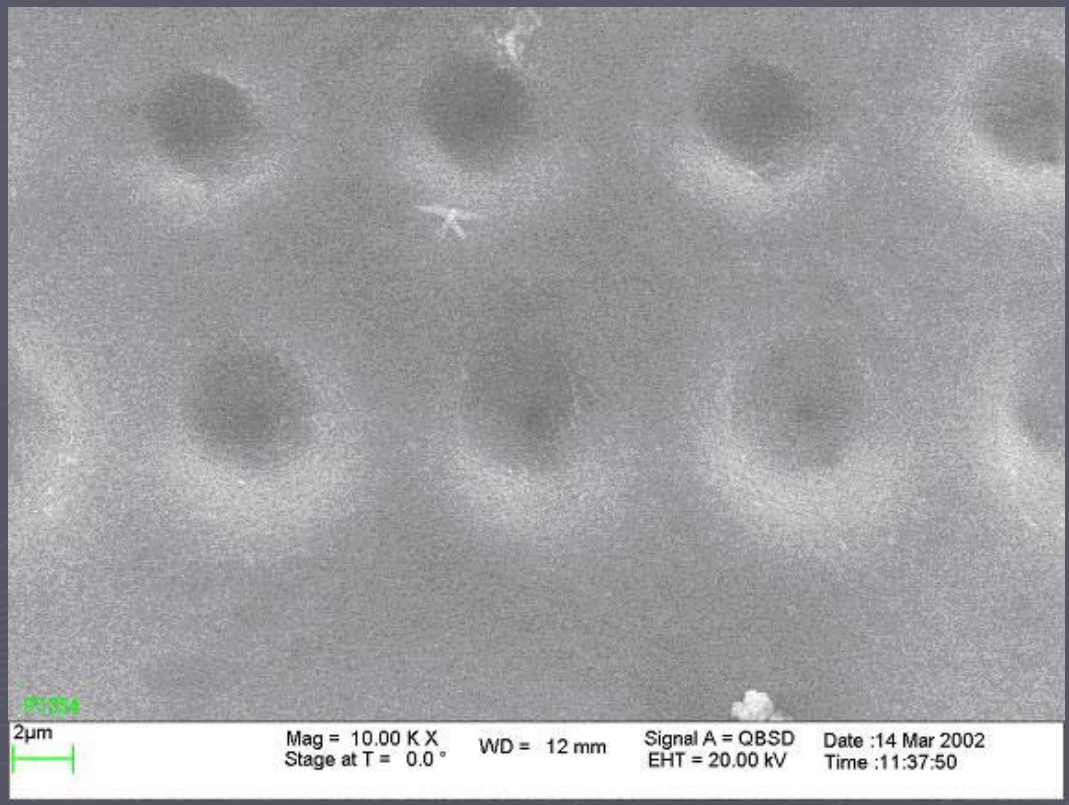
400µ Ø holes in glass



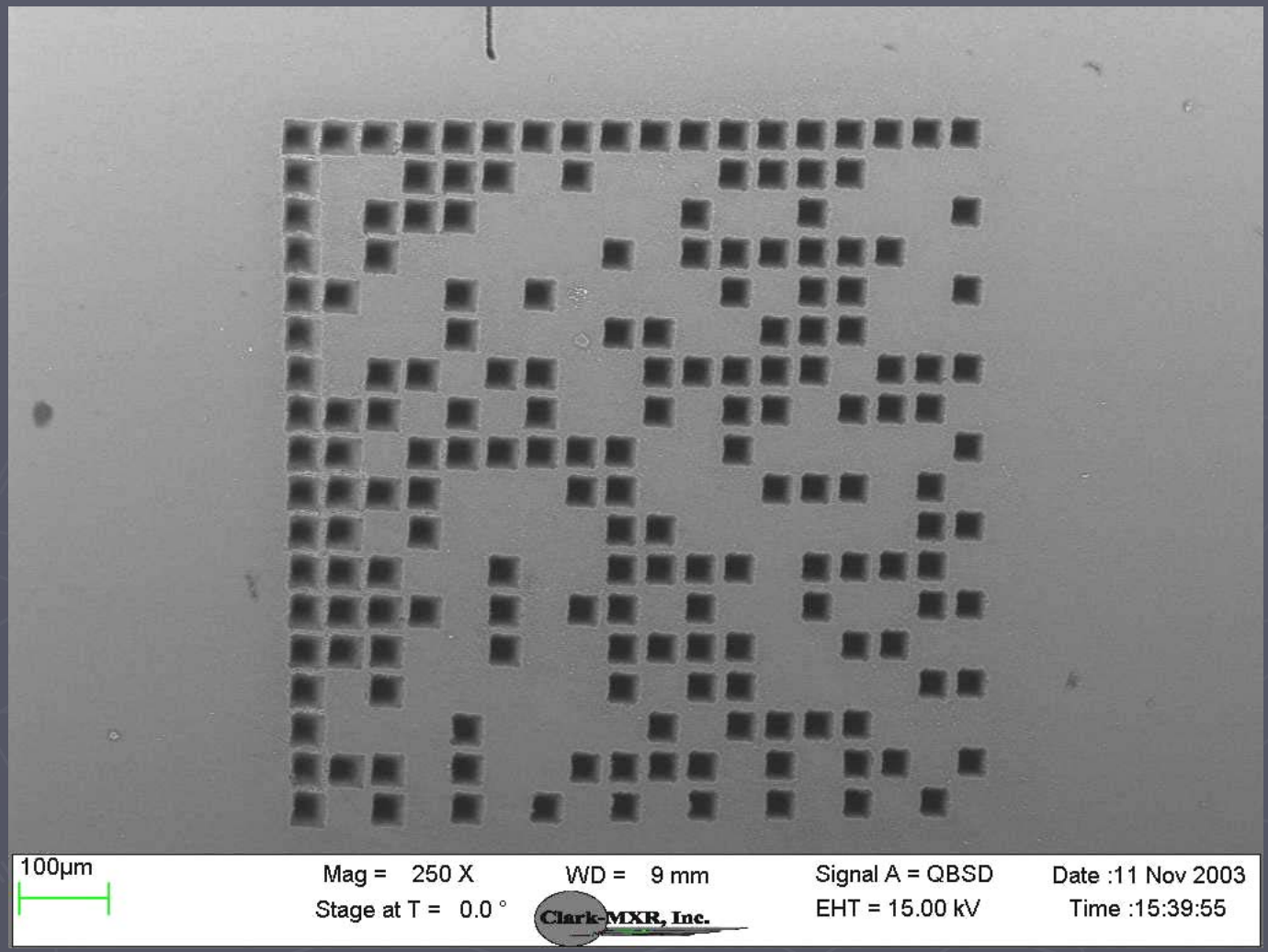
Trench in glass



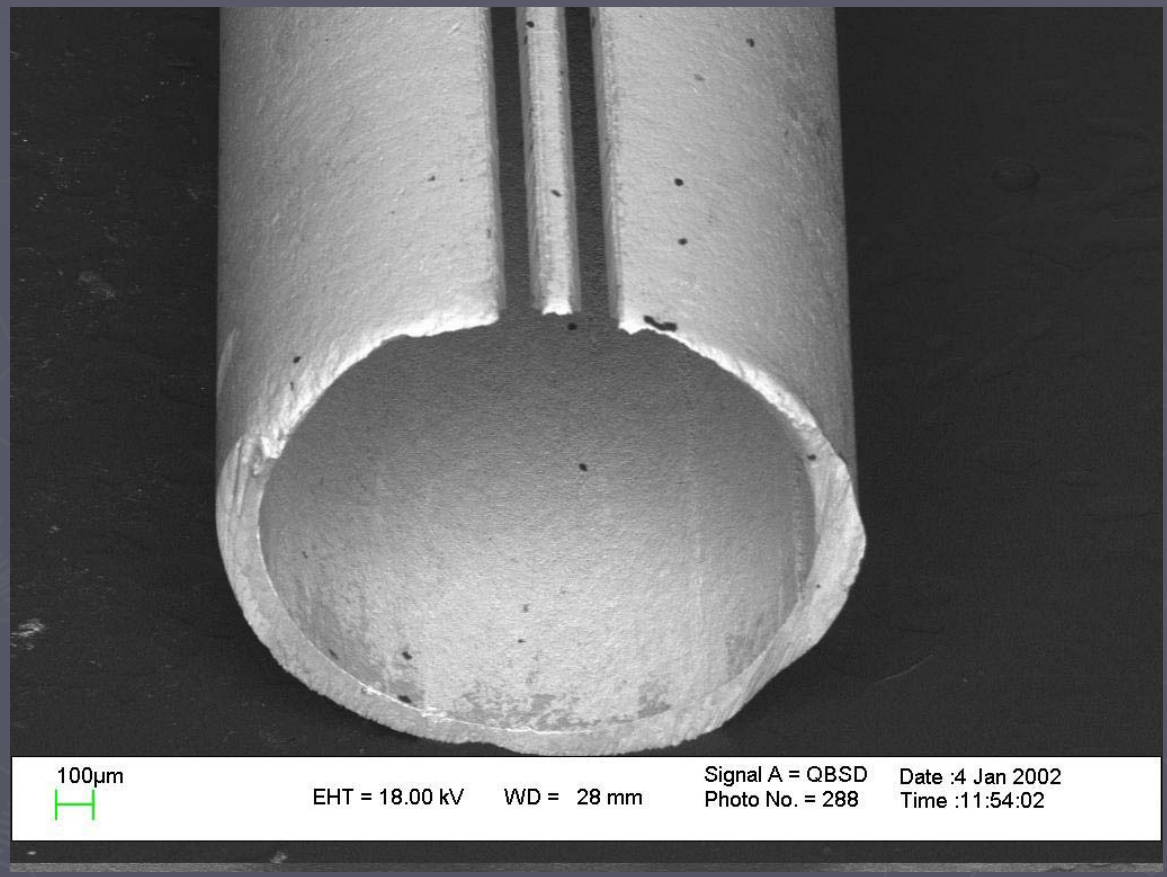
Array of pits in glass



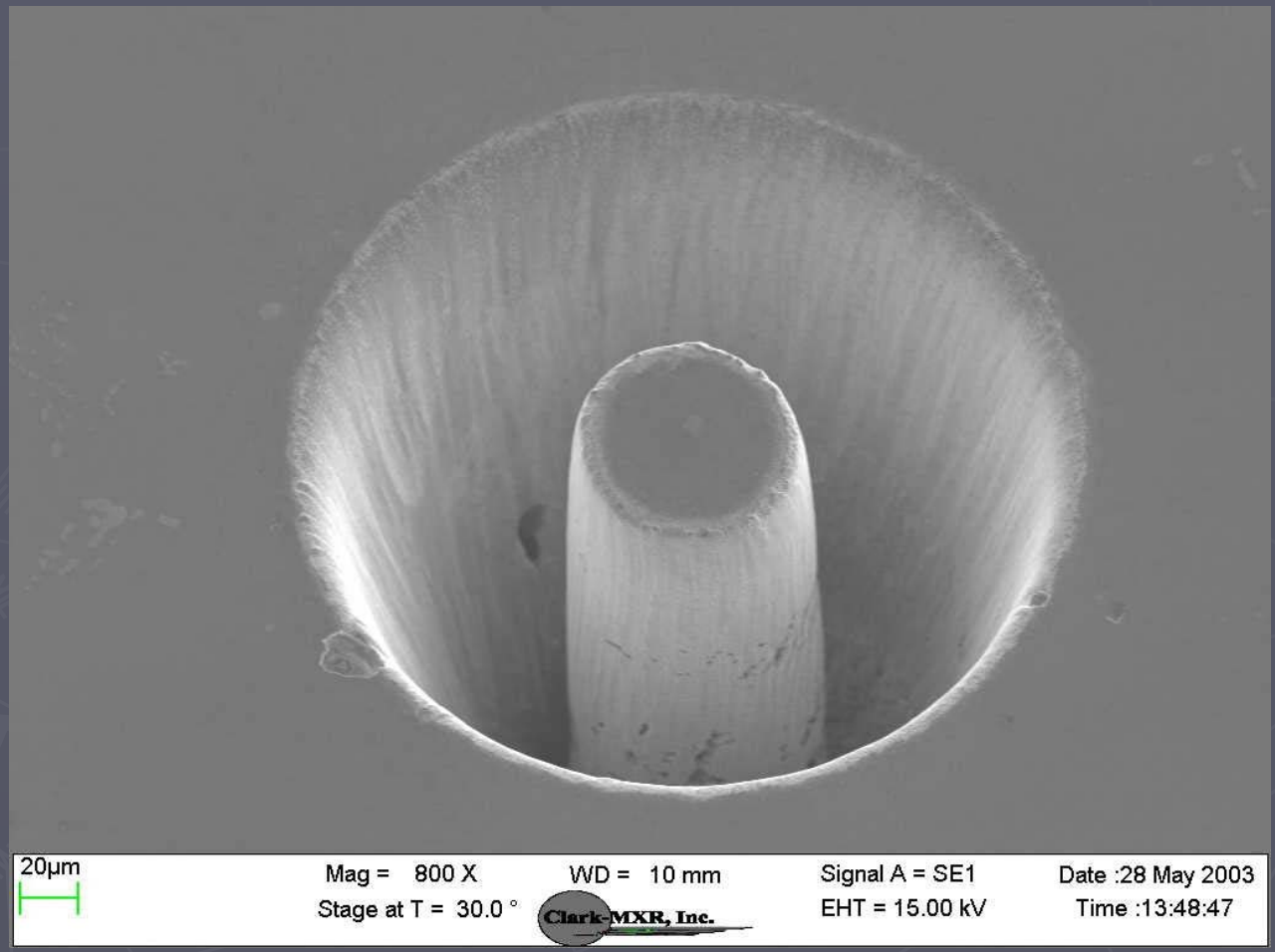
2-D bar code in glass



Slots in SS stent



Pillar in alloy (UMICH)



Highly deterministic

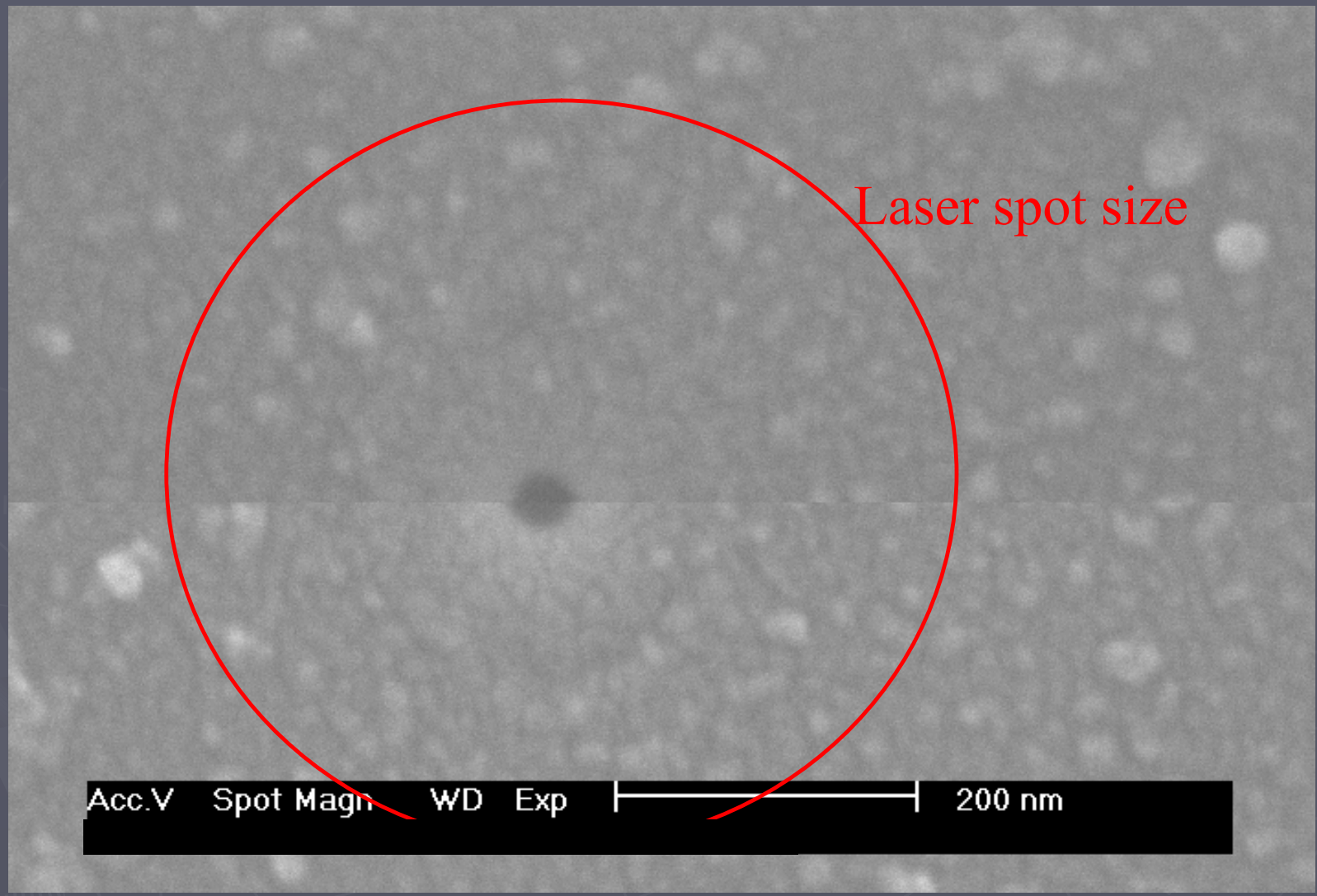


Photo courtesy of Gerard Mourou, University of Michigan.

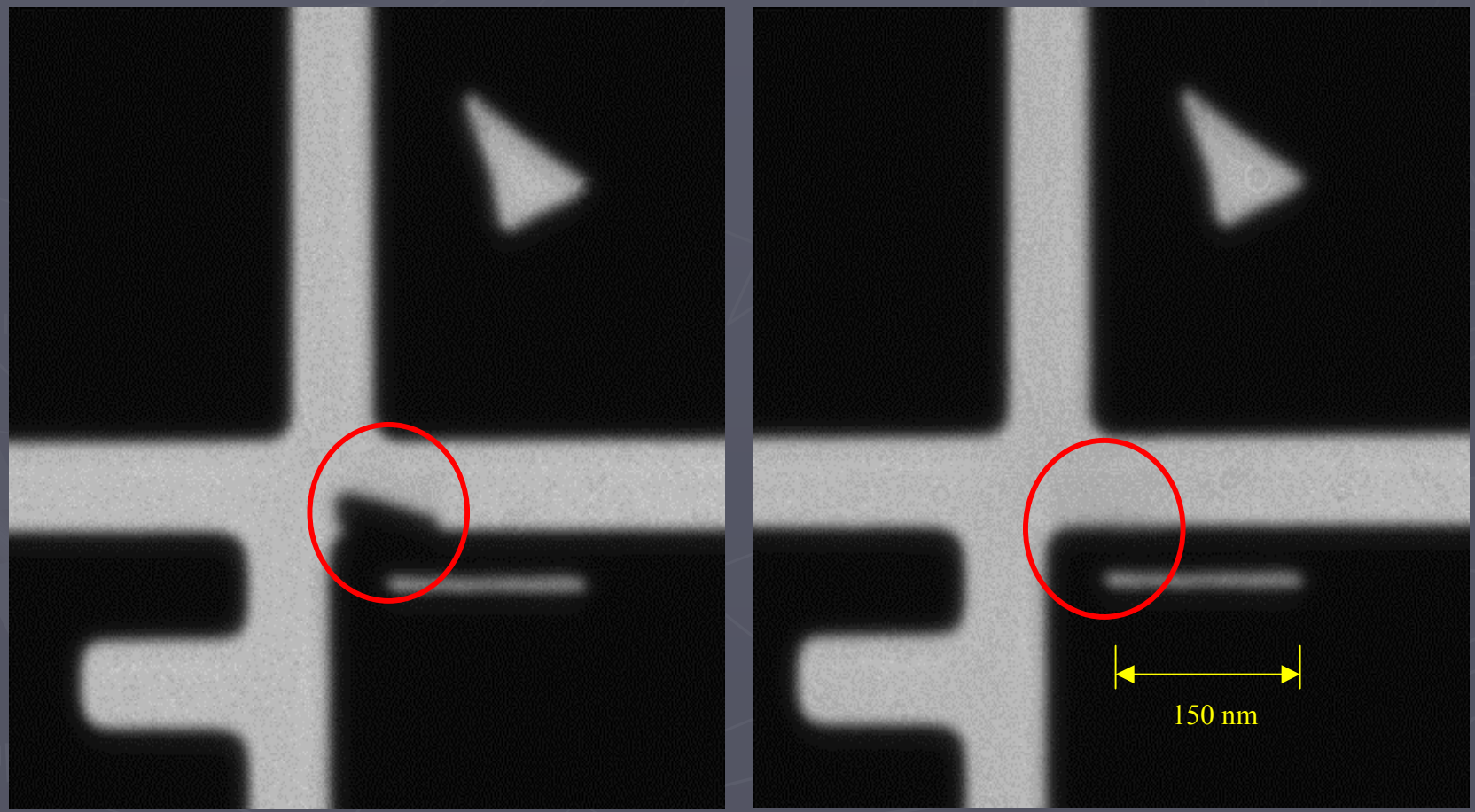
LASIK Eye Surgery

- Microkeratome
- PRK using Femtosecond Laser (Intralase Corp.)
- Procedure
- More info: www.intralase.com

Photomask Repair (IBM)

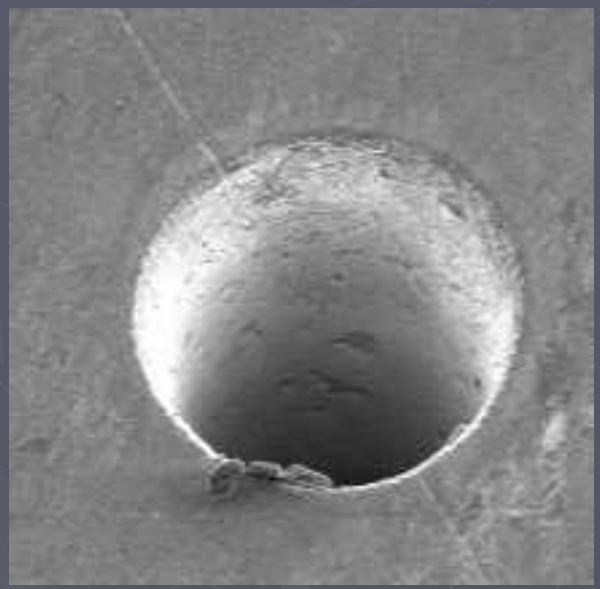
Before

After

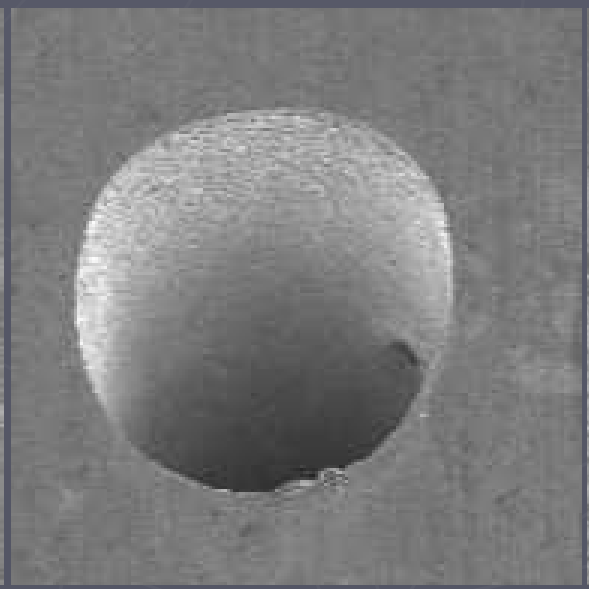


100 μ dia. thru hole in inconel (no post processing)

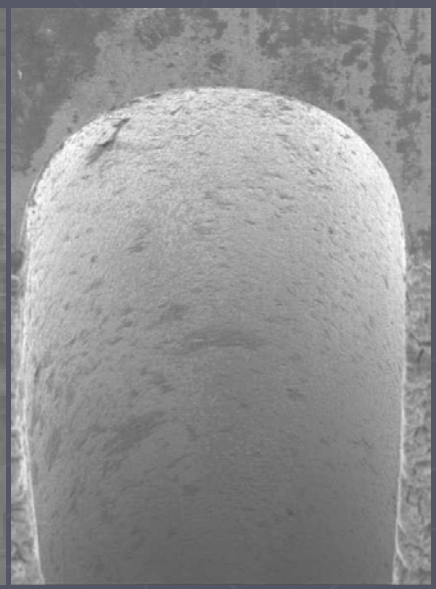
Entrance



Exit

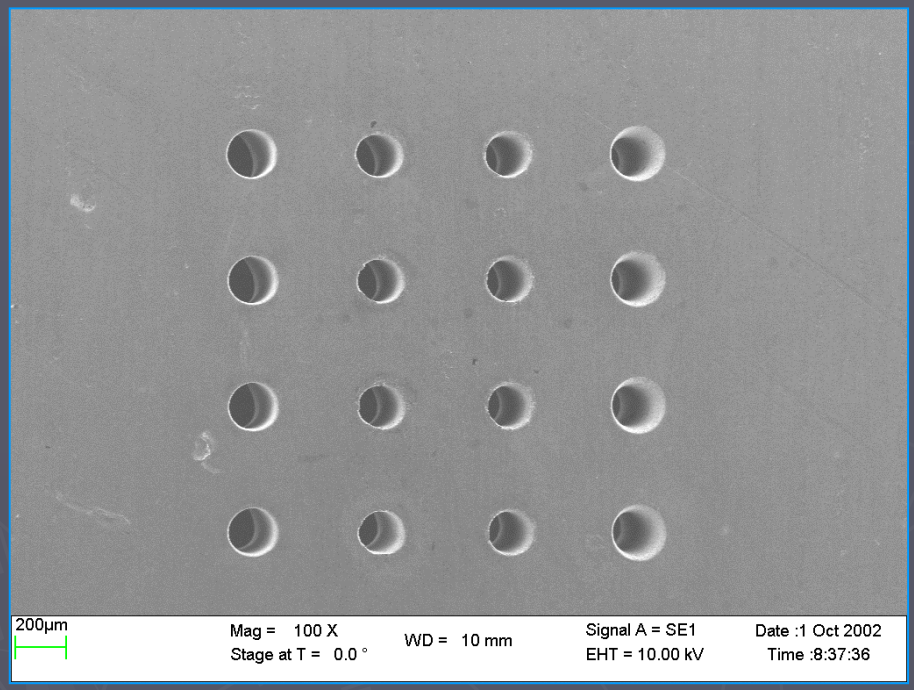


Side wall

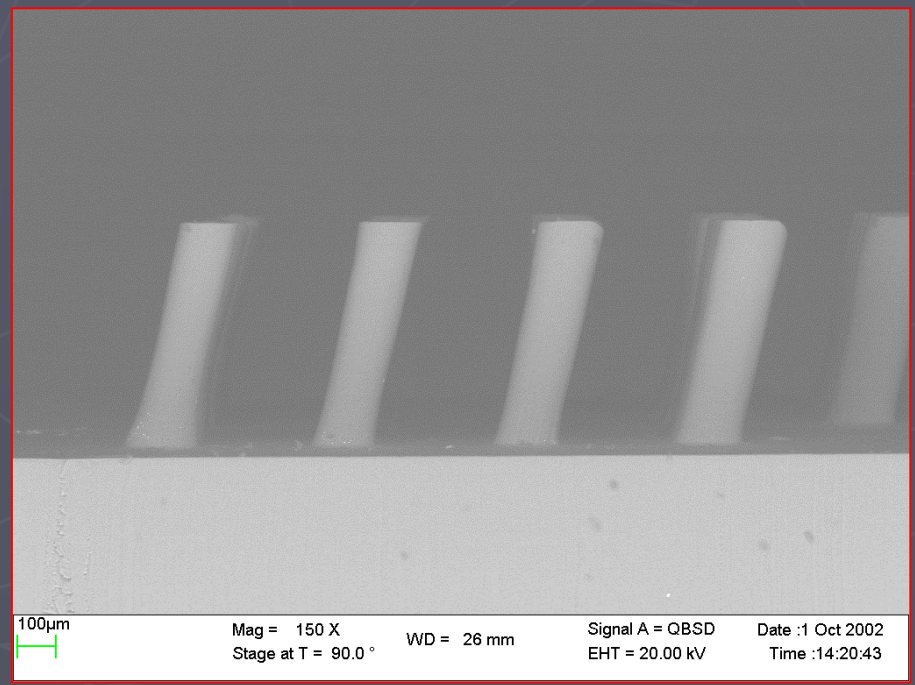


Application: Injector nozzles

100 μ dia. thru hole in inconel

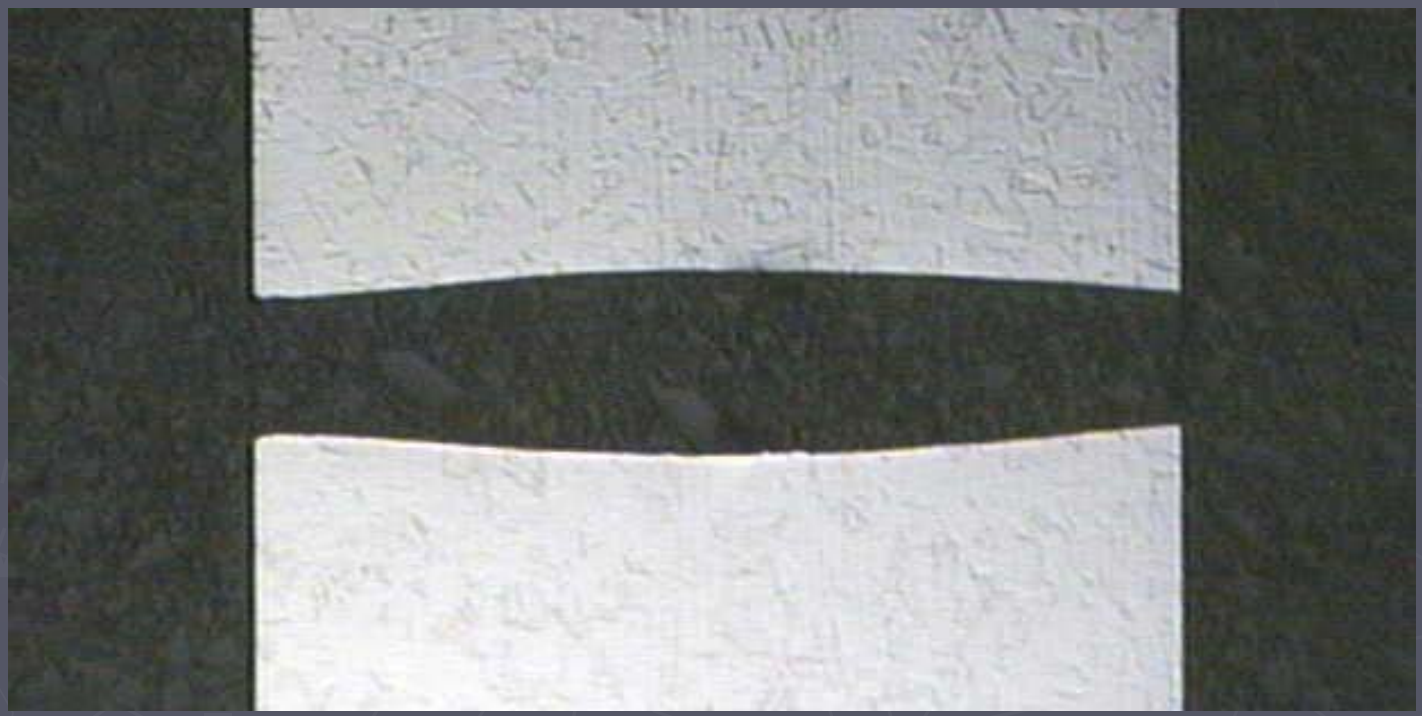


Drilled through on an ~15° angle



Casting of the above holes.

Thru hole in tungsten



EPA-mandated reduced emissions

Smaller diameter

hole →

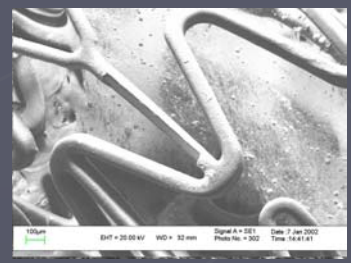
Better atomization of fuel →

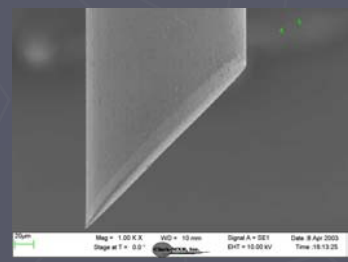
Cleaner, more efficient burn →

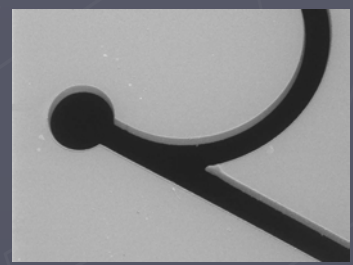
Lower emissions and greater fuel efficiency

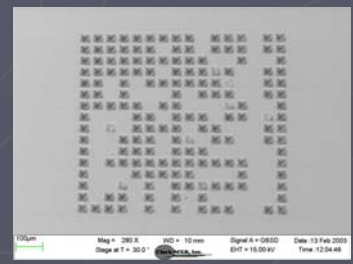
Applications on the horizon

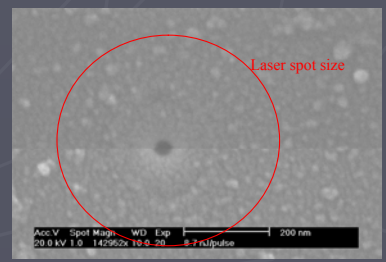
- Medical
  - Stents
  - Micro-syringes
- Microfluidics
  - Lab-on-a-Chip
- Micro-bar-coding
- Semiconductor
  - Transparent defect repair
  - Structuring on nm scale





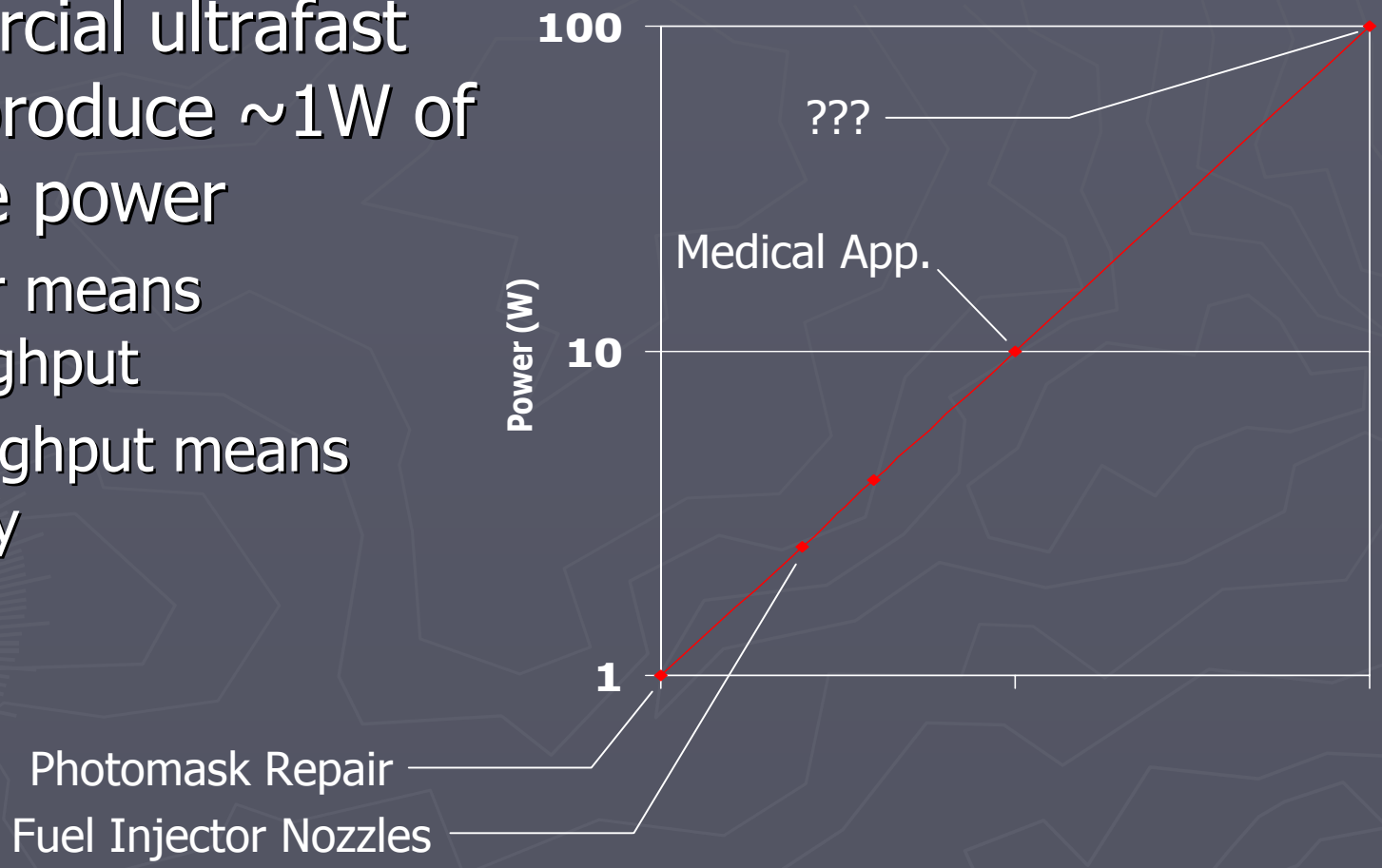






The quality is great so why is ultrafast taking so long?

- Commercial ultrafast lasers produce ~1W of average power
  - Power means throughput
  - Throughput means money



Can ultrafast solve my problem?

- To find out you can…
  - Workstations
    - UMW series
  - Lasers
    - CPA-21xx-i series systems
  - Applications lab
    - Fully equipped ultrafast micromachining and inspection lab
    - Ready to test present applications or those on the horizon

Are these systems ready for industry?

The future


Clark-MXR, Inc.
Magellan

Thank you.