Semiconductor Testing Probe utilizing Silicon Whisker grown by VLS (Vapor Liquid Solid) method

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Outline

1. Objectives
2. Schematics of VLS silicon probe
3. Manufacturing (VLS method)
4. Characterization Data
5. Conclusion

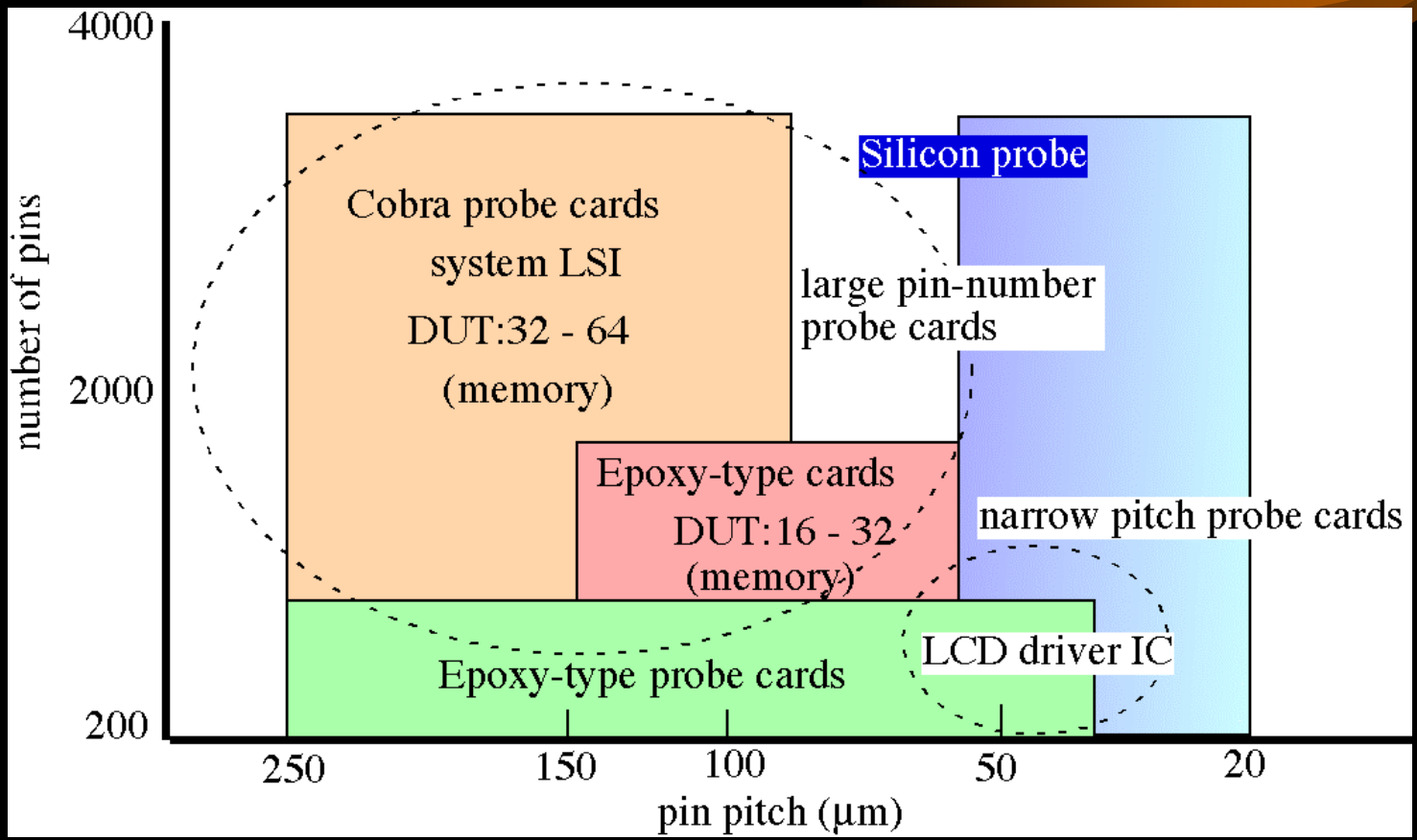
1. Objectives

- New probing technique
  for narrower pad pitch

pitch : 50 to 20μm
pin : > 1000 pins

ex. 3-dimensional packaging system LSI

Usability map of probe cards vs. pin number and pitch

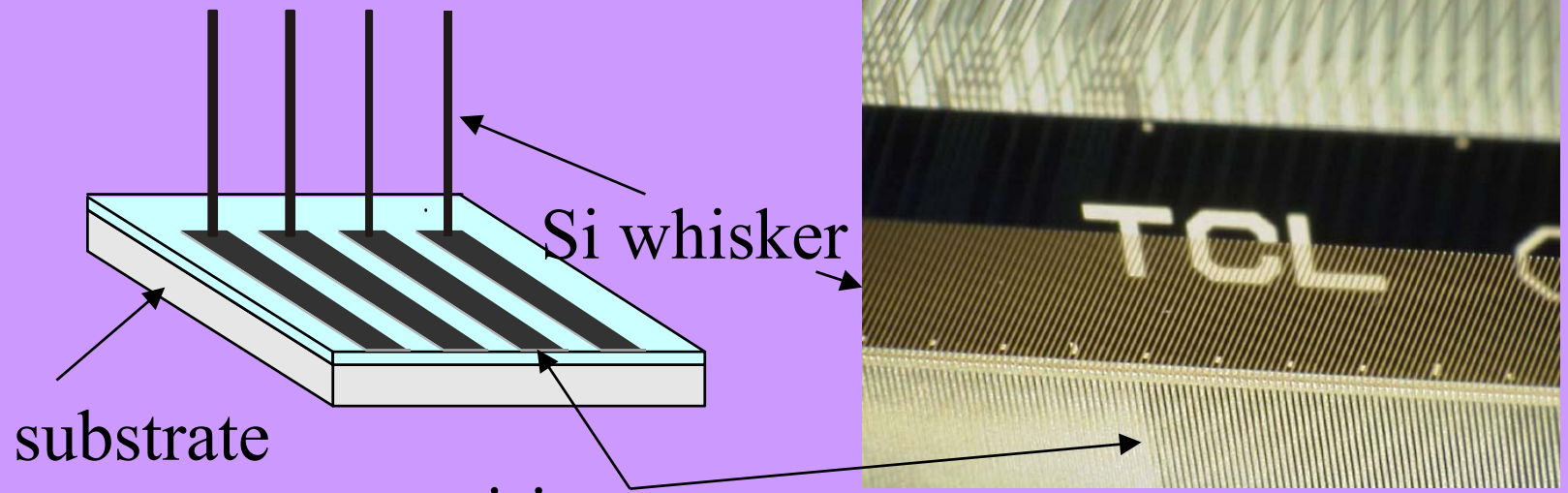


Specifications for LCD driver IC

pin pitch	**< 50μm**
pin diameter	18μm
pin length	1.3mm
OD	40μm
force / pin	900mgf
current / pin	300mA

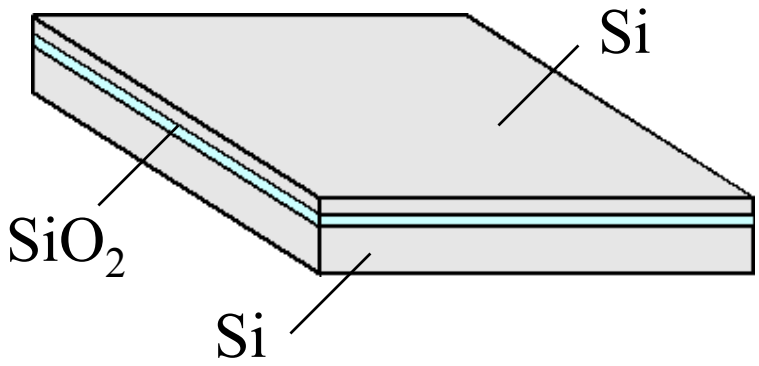
2. Schematics of the VLS silicon whisker probe

Metallized Si whiskers contacting with electrode pads.

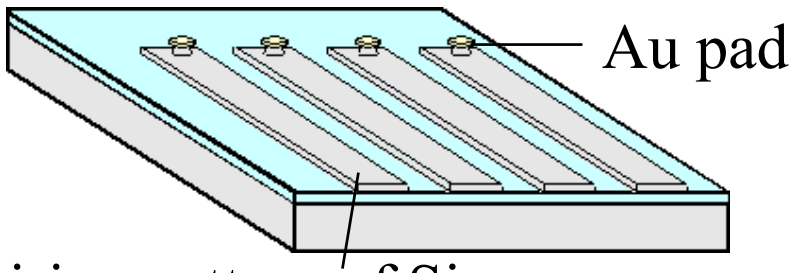


3. Manufacturing of VLS silicon whisker probe

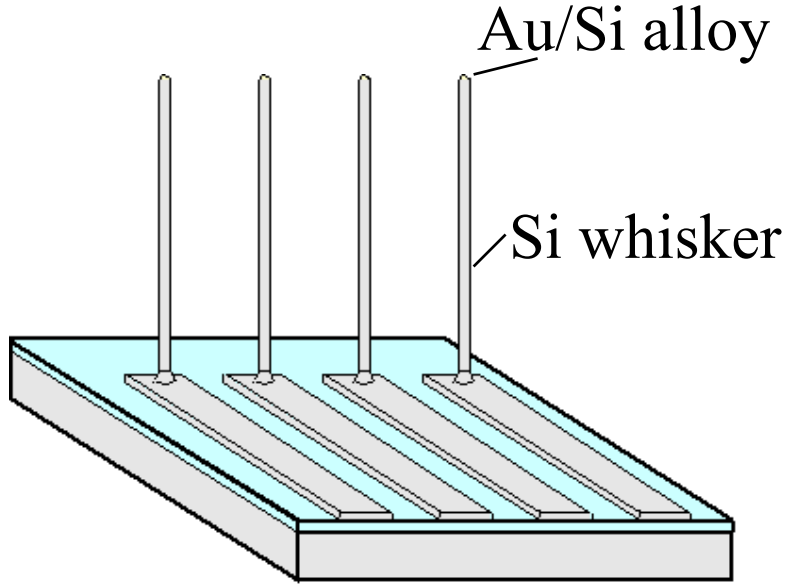
(1) *substrate (SOI)*



(2) *lithography and plating*

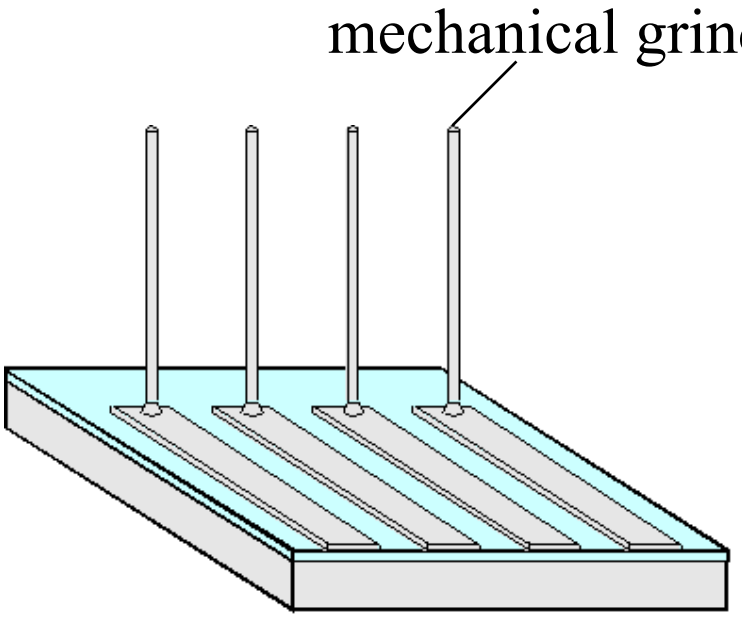


(3) *VLS growth*

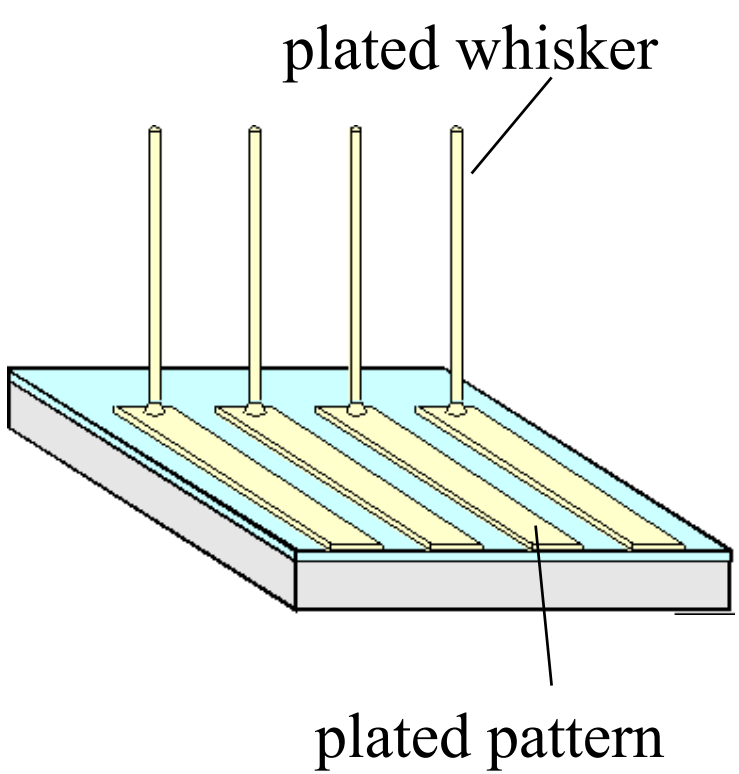


3. Manufacturing of VLS silicon whisker probe

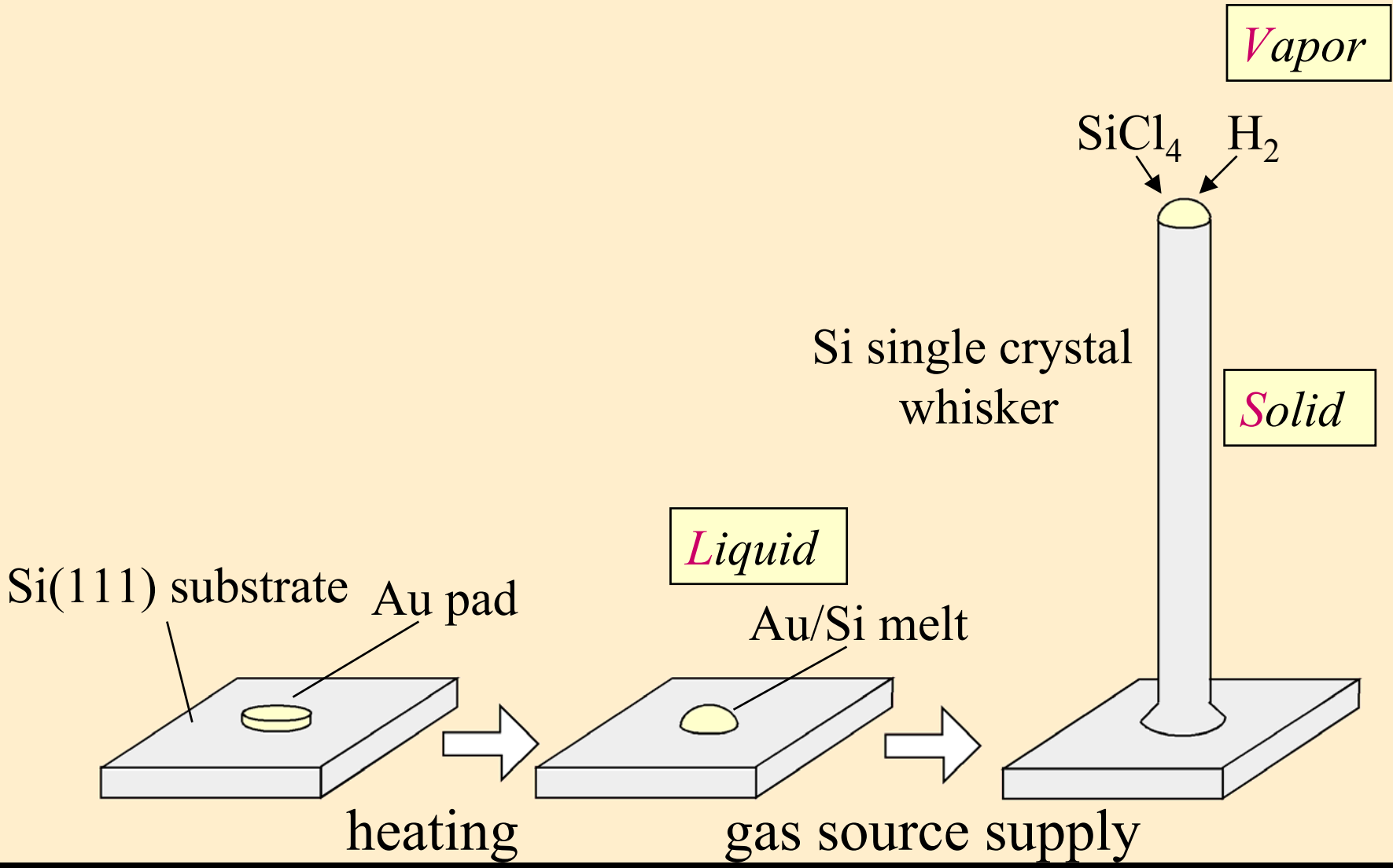
(4) *trimming*



(5) *metallization*



VLS growth mechanism



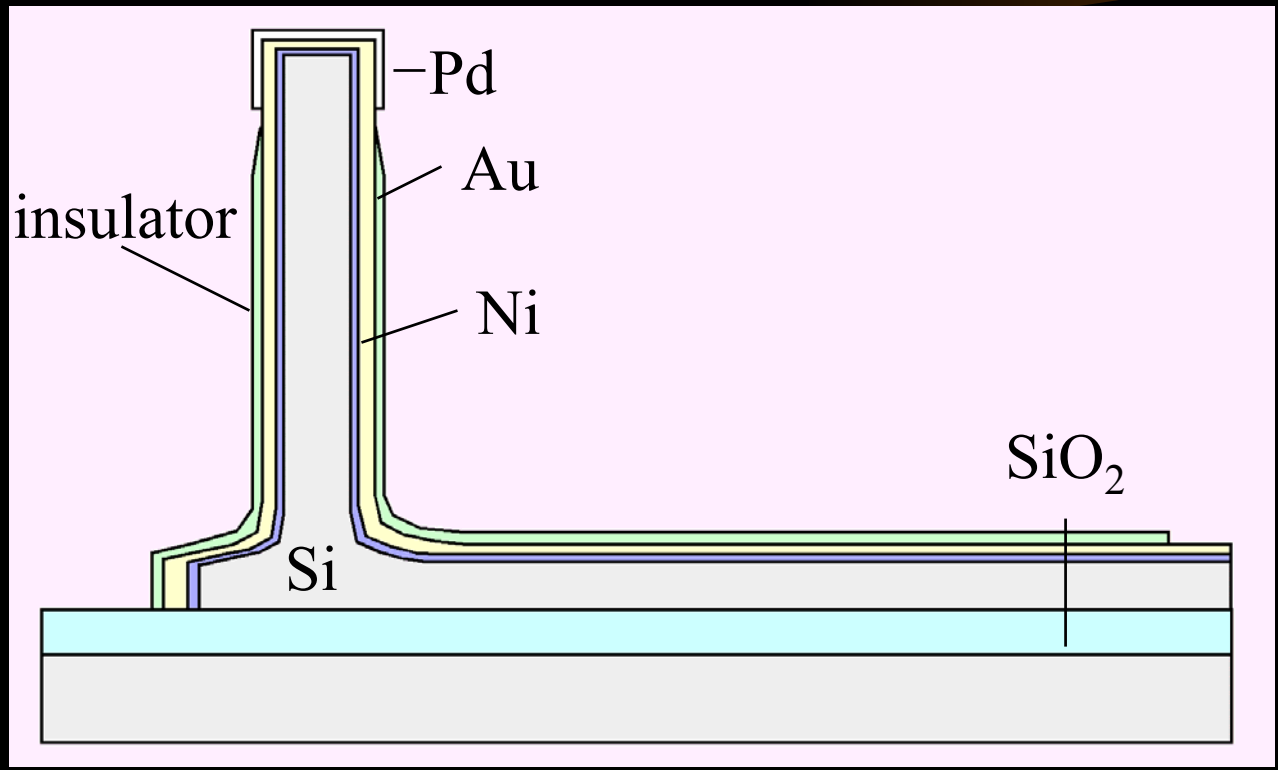
3. Manufacturing of VLS silicon whisker probe

- Silicon is plated with metal to obtain sufficient electrical conductivity.

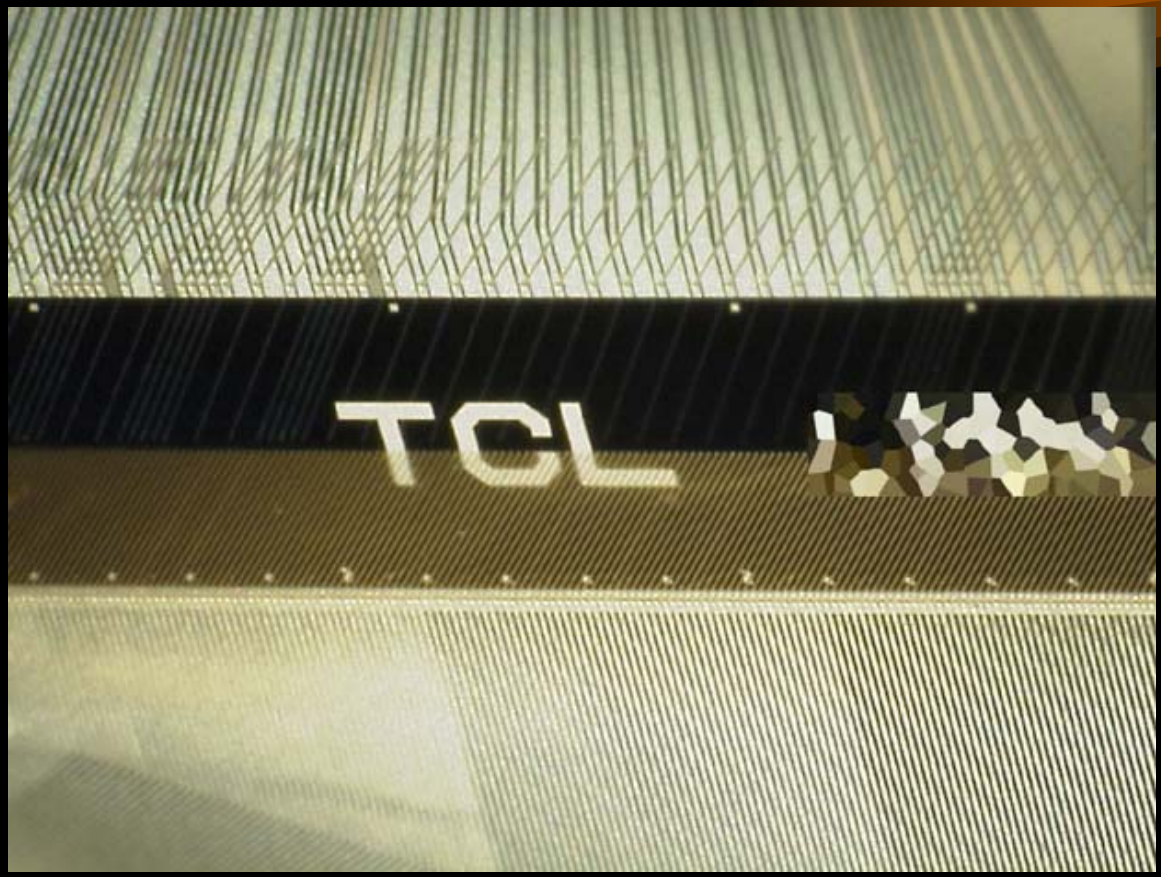
- Pin positions and wiring patterns are determined by photo-lithography.

  ⟶ pin position is arbitrary and has higher accuracy.

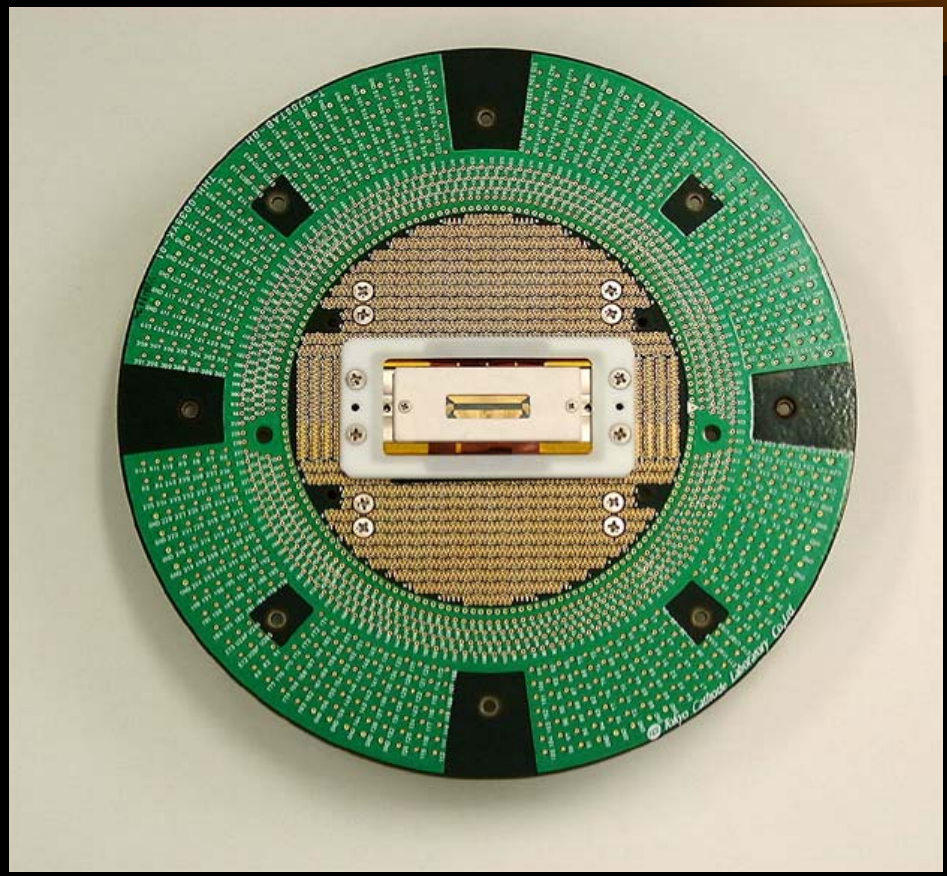
Profile of VLS silicon probe pin



Overview of the VLS silicon probe chip



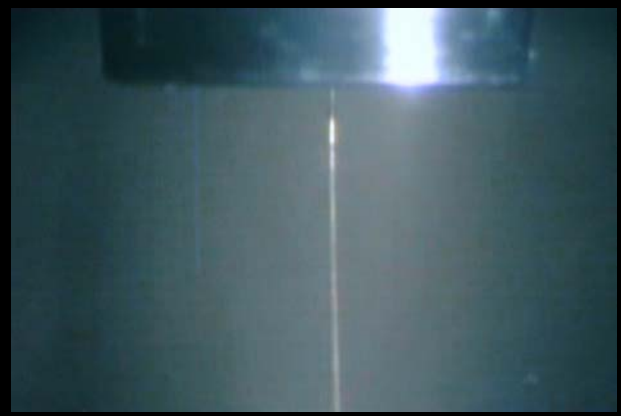
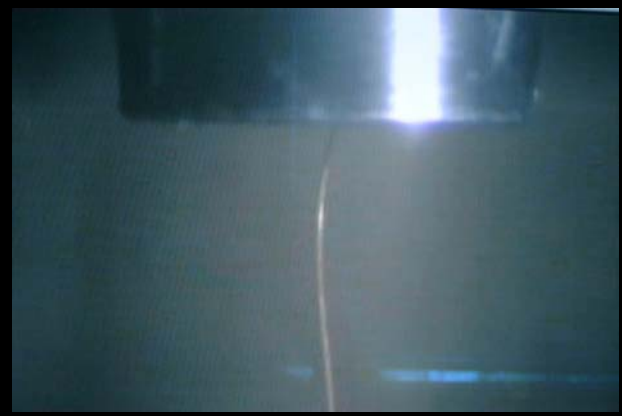
Overview of the VLS silicon probe card



4. Characterization Data

- Pin deformation with overdrive
- Probe force with overdrive
- Reliability (resistance …)

Deformation of VLS silicon pin with overdrive

Probe pin deforms with buckling mode

⟶ Scrub motion of the pin point is small.

Conclusion

1. Si single crystal whiskers can be formed at arbitrary positions on Si substrate using VLS growth method. Utilizing this technique, semiconductor testing probe cards can be manufactured.
2. The VLS chip with 40μm pin-pitch has sufficient character for the application of probe cards.
3. Advantage - lowering pad damage
   Disadvantage - low removability of contamination of the pads.
4. Prototype probe-tip with narrower pin pitch (20μm) is being developed with the same technique.