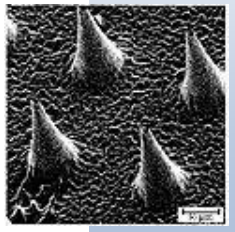
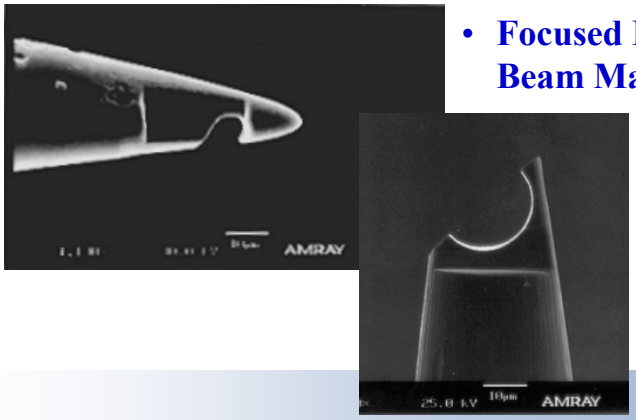
Microsurgery, Microneedles, and Drug Delivery



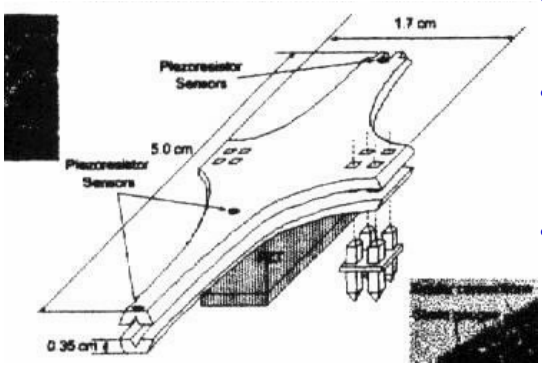
Dr. Bruce K. Gale

Microsurgical Tools



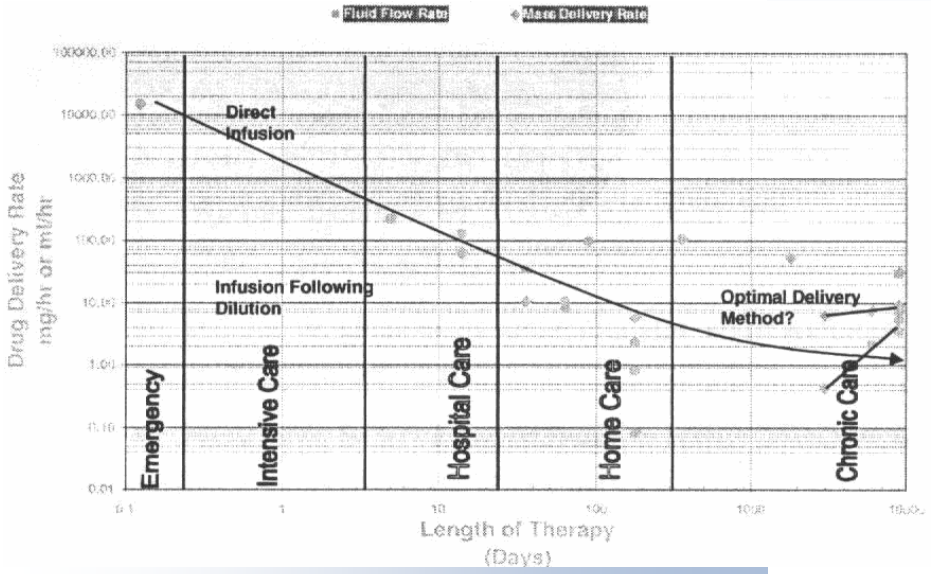
- **Focused Ion Beam Machining**

Surgical Tools



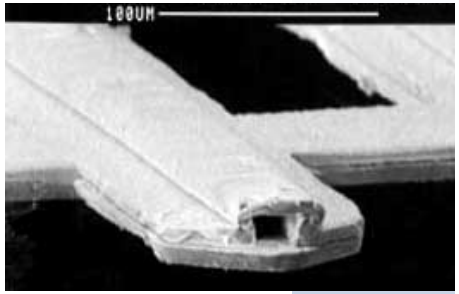
- Ultrasound transducers for cutting
- Piezoresistors for control and setup of gradients
- Thin films for cutting
  - Can be nm in thickness
    - Less than cell size
  - No blunt tip

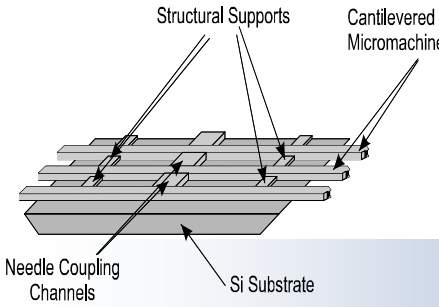
Drug Delivery Rates

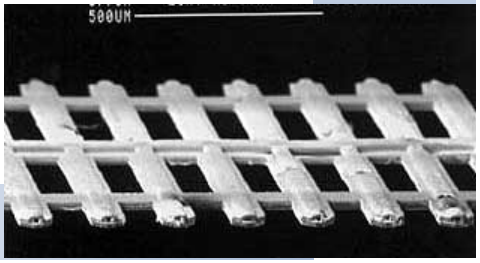


Microneedles

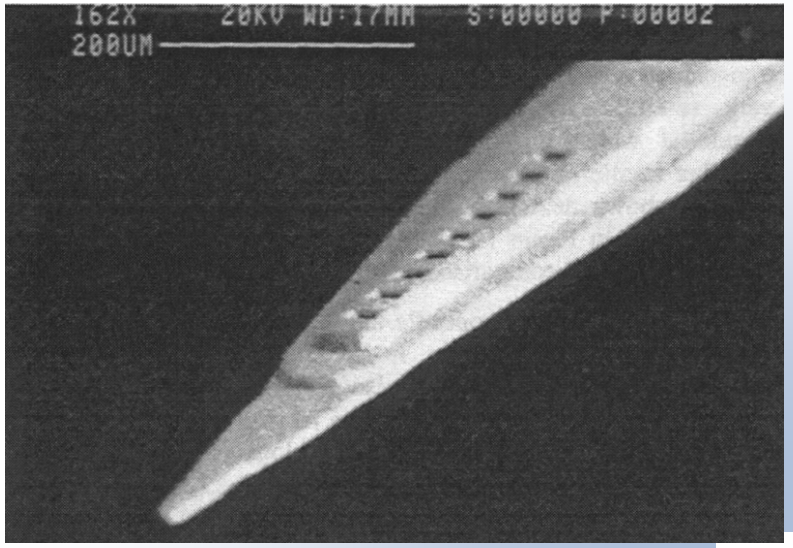
- Microneedles allow collection and dispensing of microsamples
- Large array required to dispense and collect necessary volumes
- Packaging the primary limitation



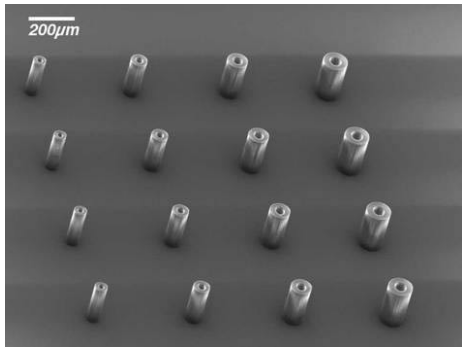


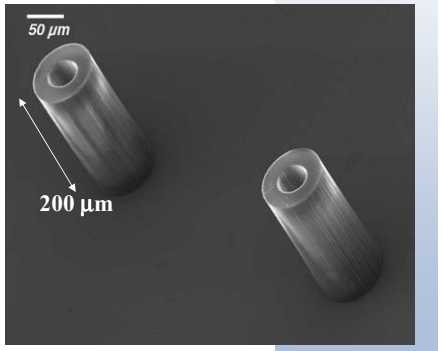


Microneedles

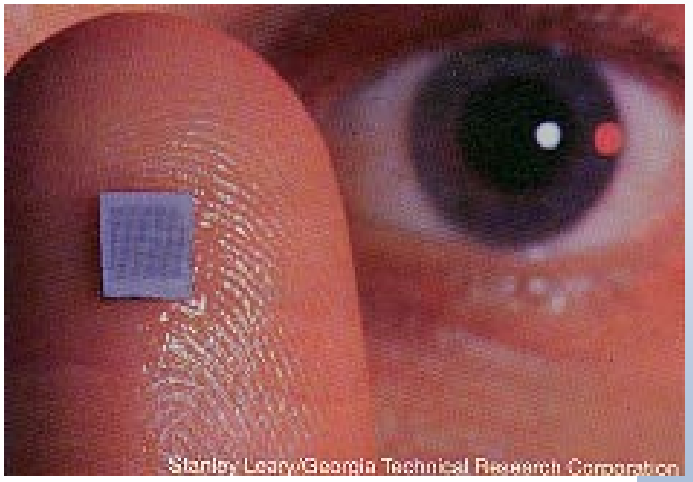


LIGA Microneedles



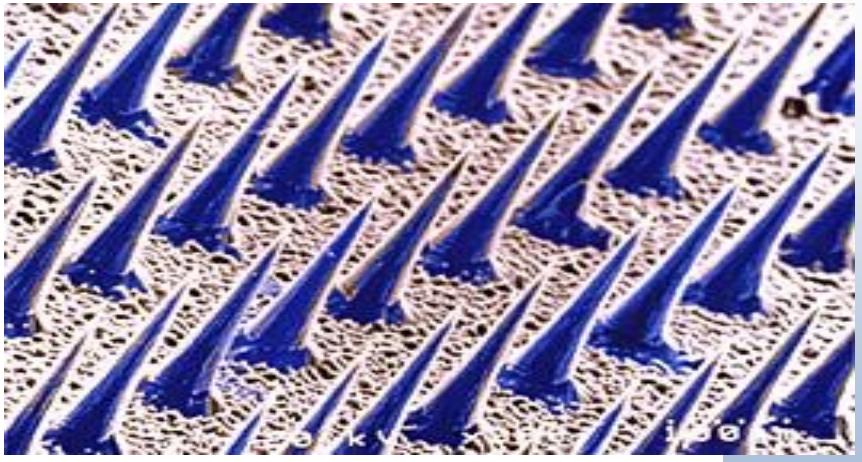


Planar Microneedle Array



Photomicrograph of a 20×20 array of solid microneedles resting on a human finger to give a sense of its small size.

Planar Needle Array

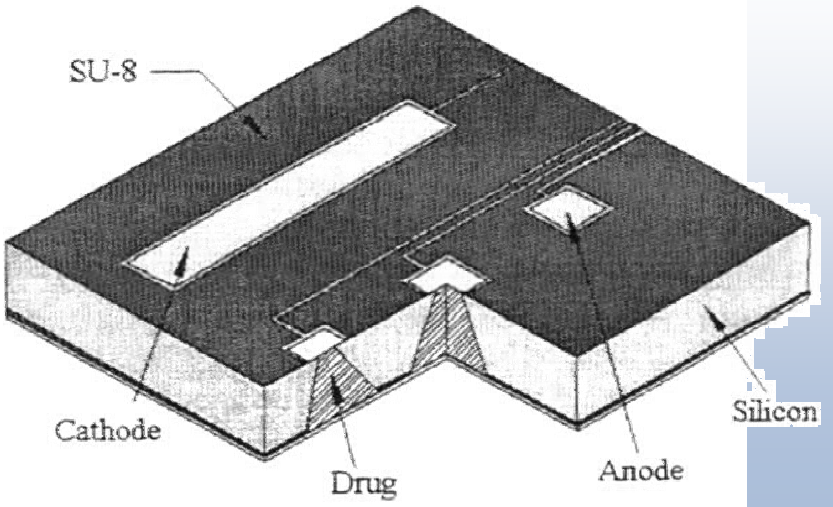


An SEM image of a portion of an array showing sharp and uniform needles

Typically polysilicon

Can be atomically sharp if made using self occluding mask

Reservoirs for Drug Delivery



Caps for Drug Release

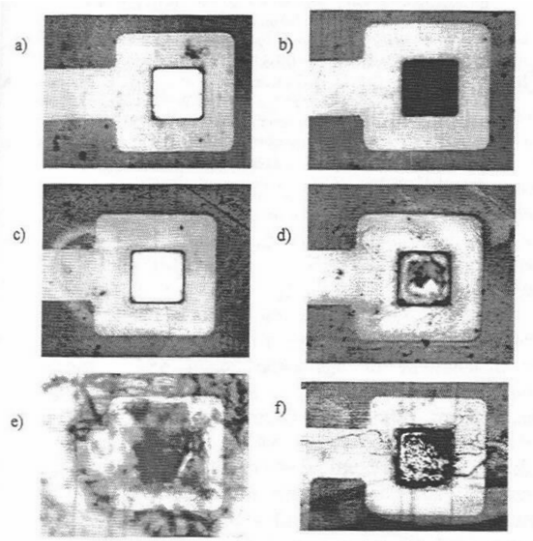
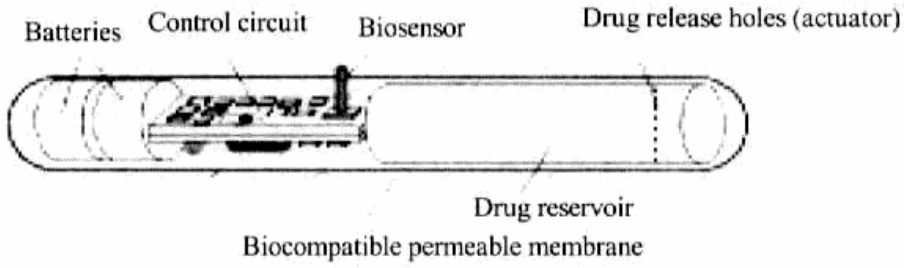


Fig. 4. Pictures of gold caps after release. a) Cap in PBS with no applied voltage b) An opened cap in PBS c) A cap in serum with no applied voltage d) A cap in serum which partially corroded but did not open e) and f) Opened caps in serum that still show the gel. The gold film broke but was not entirely removed. The area of gold exposed to solution is 50 microns square.

Implantable Controlled Capsule



- Holes open to allow drug to diffuse out
- Modified version incorporates piston