Writing the Future

Novel Deposition Systems for Combinatorial Libraries

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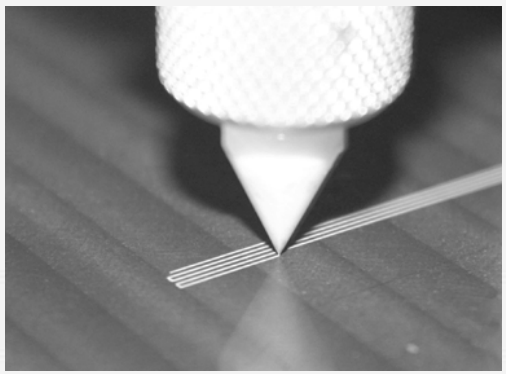
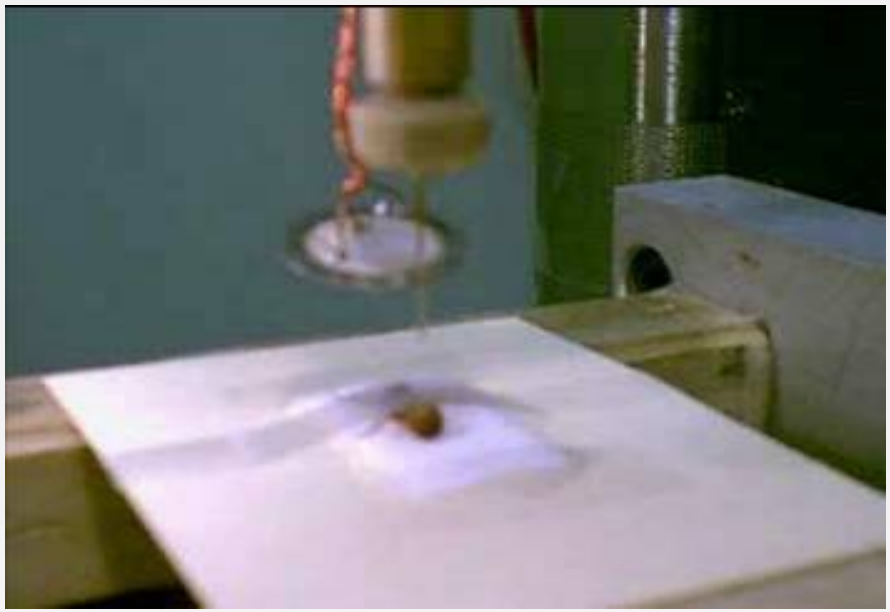
Real Platforms for Real Results

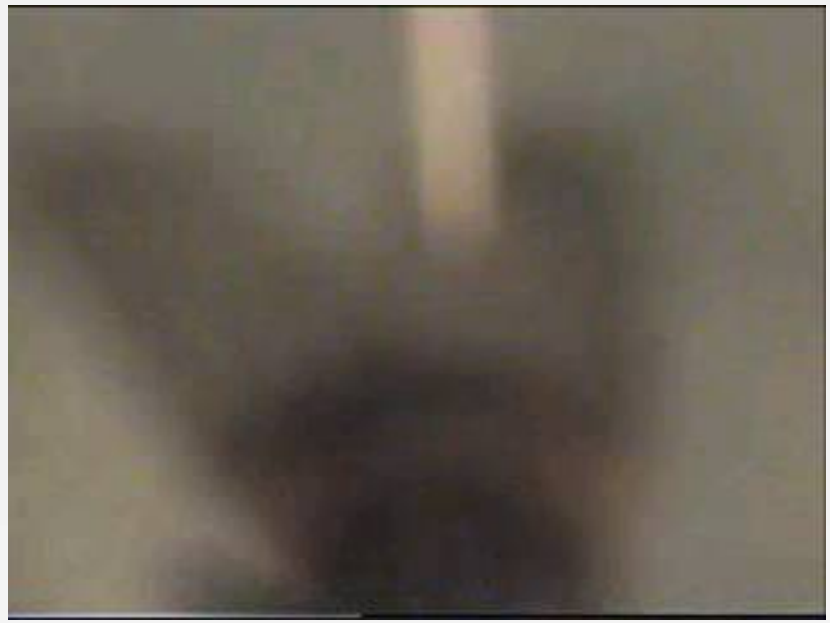
DARPA, under the Meso-Scopic Integrated Conformal Electronics (MICE) program, developed Direct Printing tools and processes.

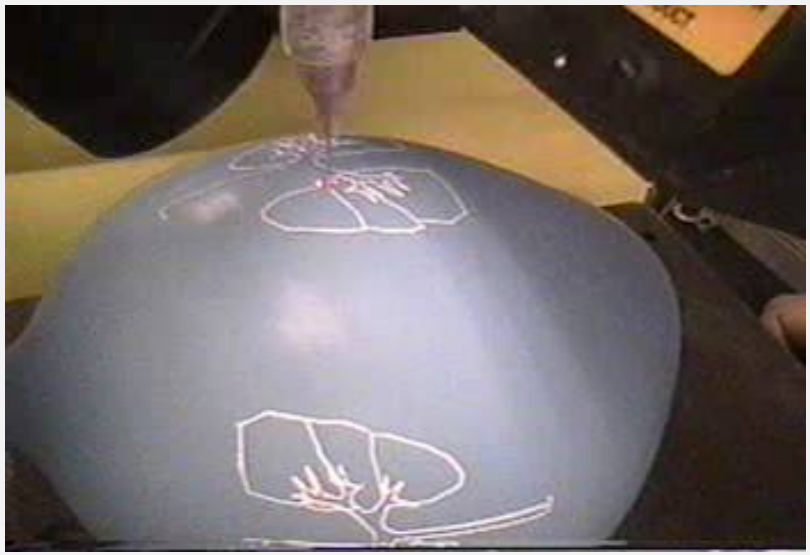
The addition of short pulsed lasers and advanced imaging makes these platforms the most sophisticated micro bio-electronic tools in the world today.



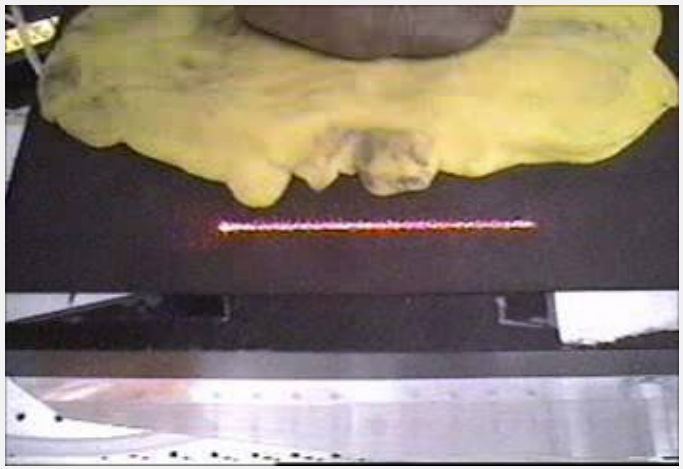
Printing “any” material on “any” substrate has opened doors for conformal and 3D biological integrated electronics.



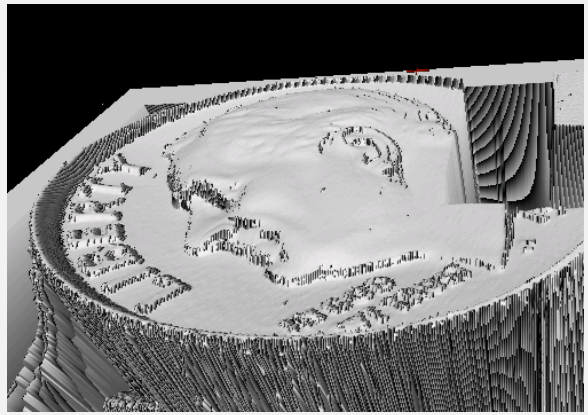




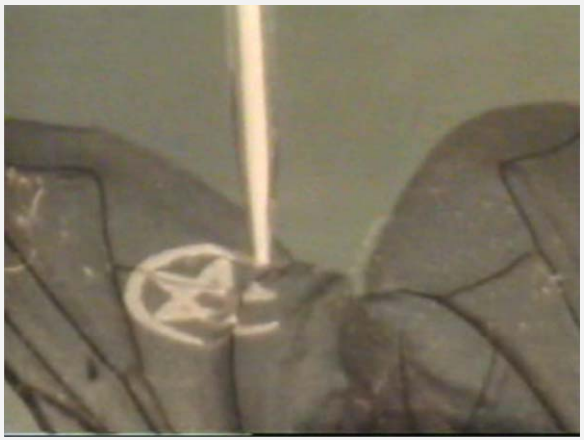
Z Tracking must be accurate to microns or less



Pre-Scan



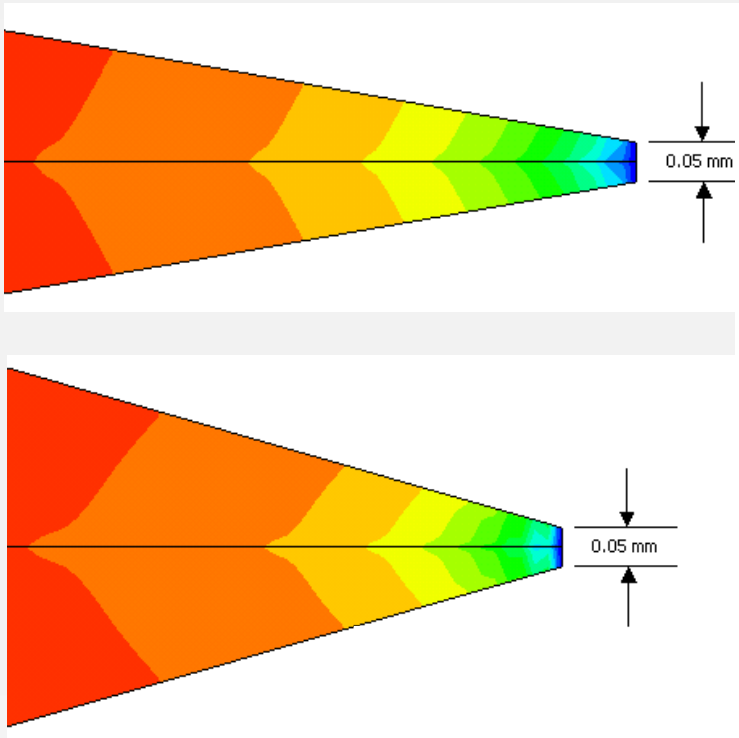
Vision – Define Plane

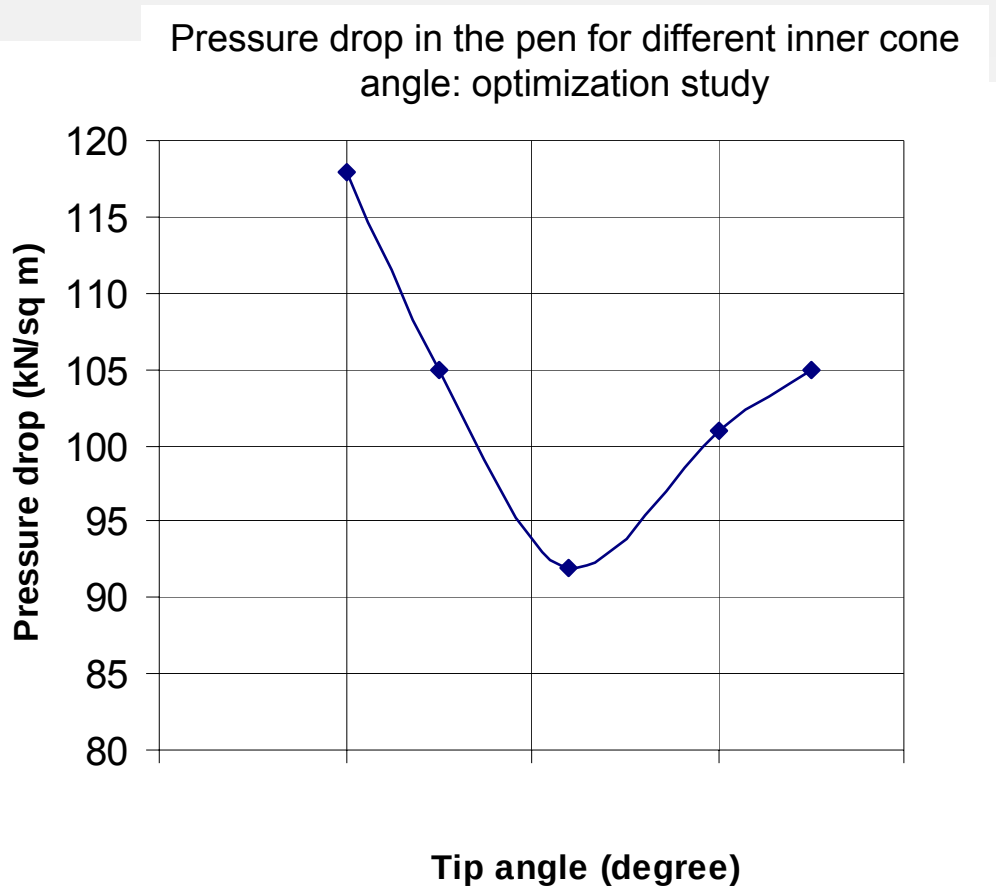


Touch Probe Feedback

Real Time Dynamic Laser

Optimization of the tip angle

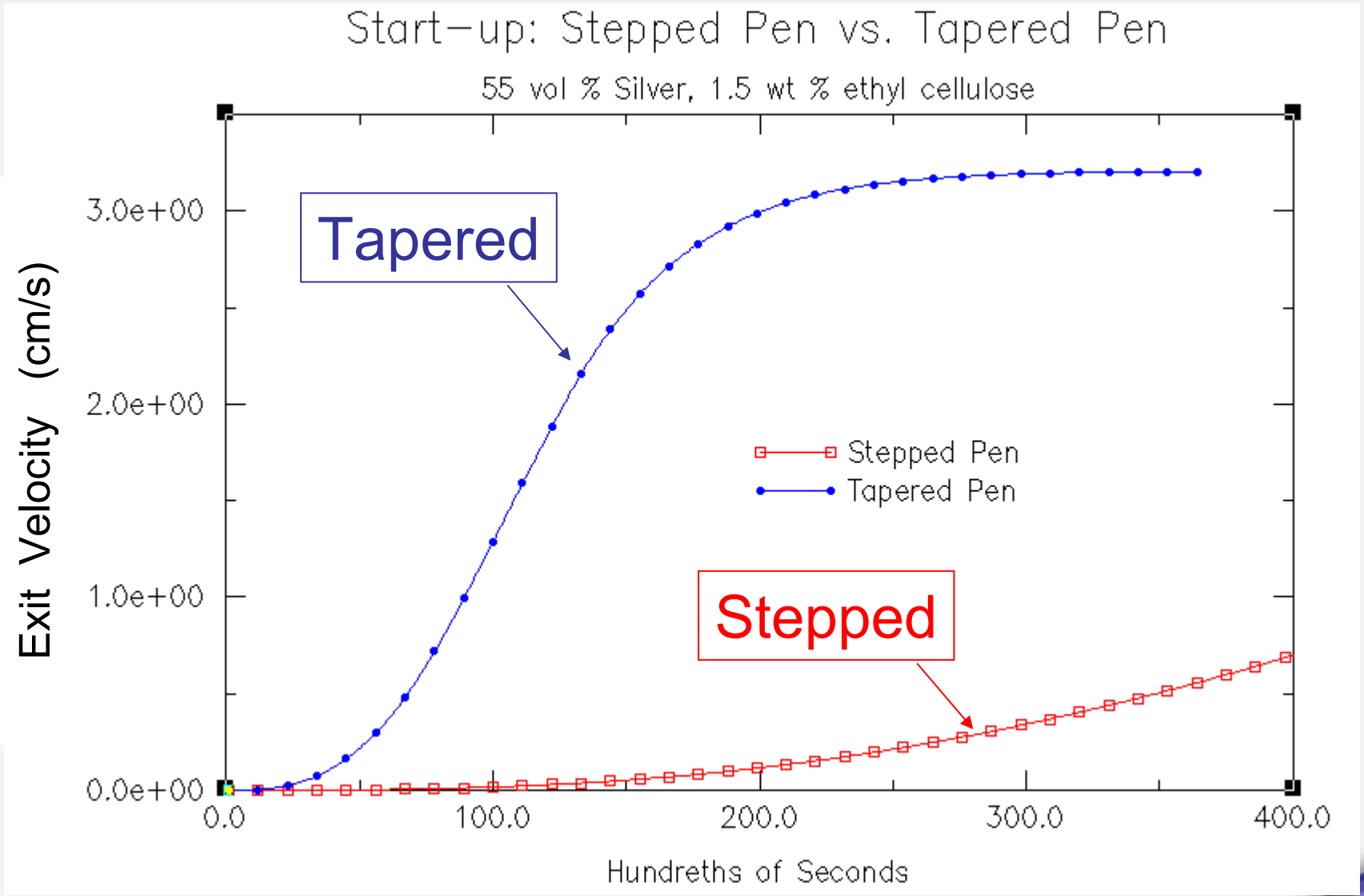




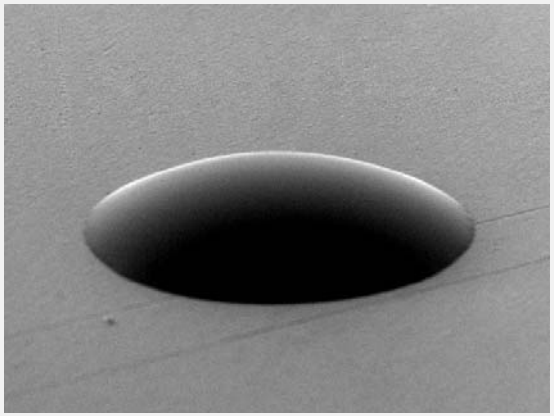
Conclusion:

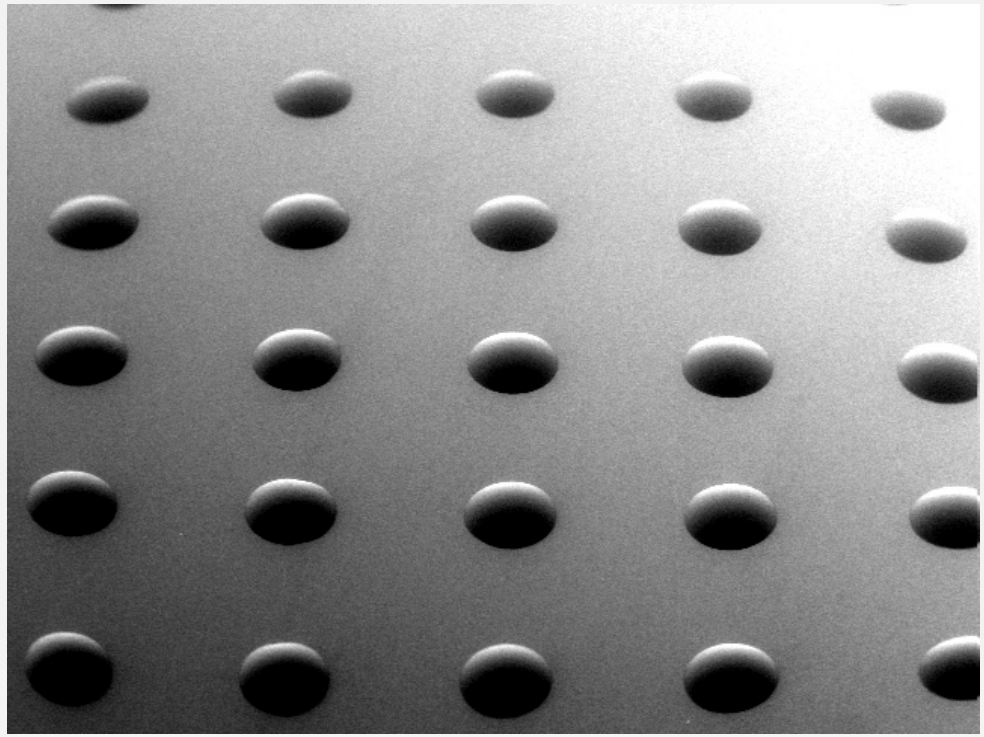
A small range of tip angles are required to achieve optimum minimum pressure drop along with nearly uniform axial velocity distribution at the tip, resulting in enhanced start/stop.

Start-up Comparison

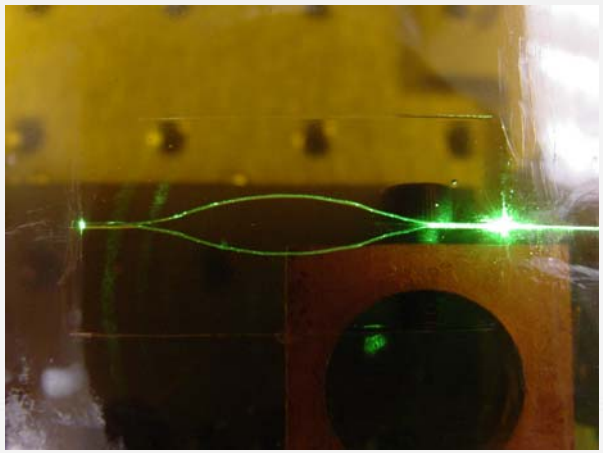


True Start/Stop is an Enabler





- Micro-Lenses
- Integrated Optical Waveguides



From Antennas to Much Smaller Antennas to Micro Antennas and Rectennas

Solving future electronics with nano development => nano-electronics

So why don't they solve the future of antennas, is it because it is done?!!?
Is it because we have reached the limits of antenna physics or the limits of traditional antenna design?

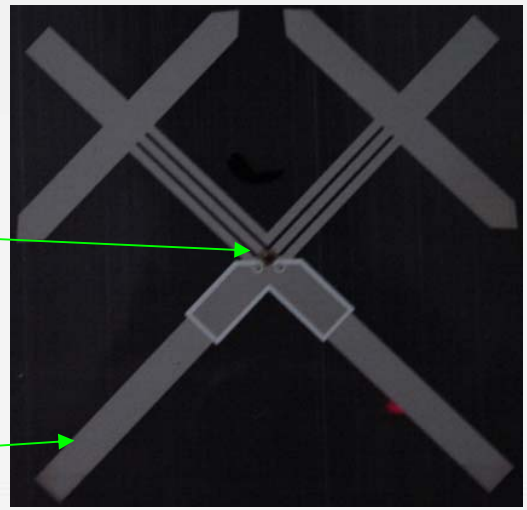
Evolutionary optimization can be used for antennas and connection to RF circuits.

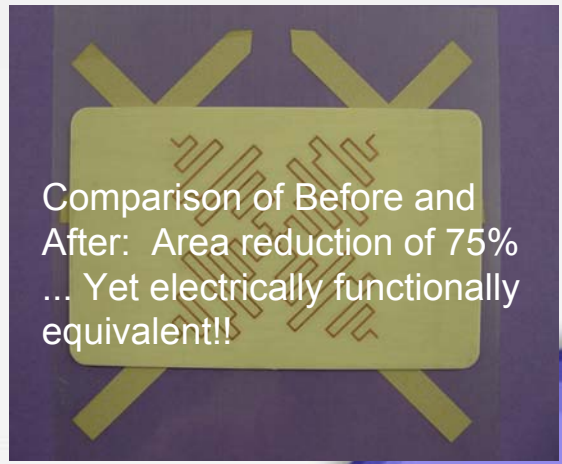
This combination can also provide functional devices without batteries….using rectenna.

RFID Tags – "Tag the World"

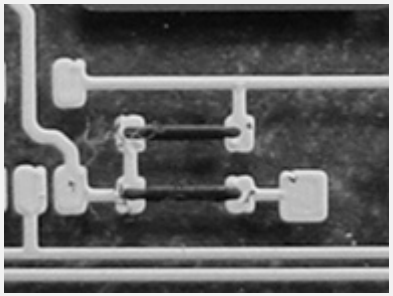
Tags are the size of a grain of salt!

Antennas are the size cereal bowl!

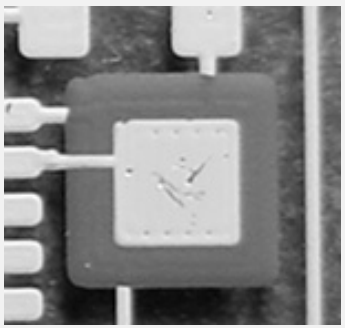




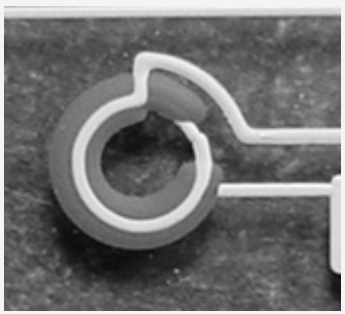
Print Passives from “Raw” Material



Resistors



Capacitors

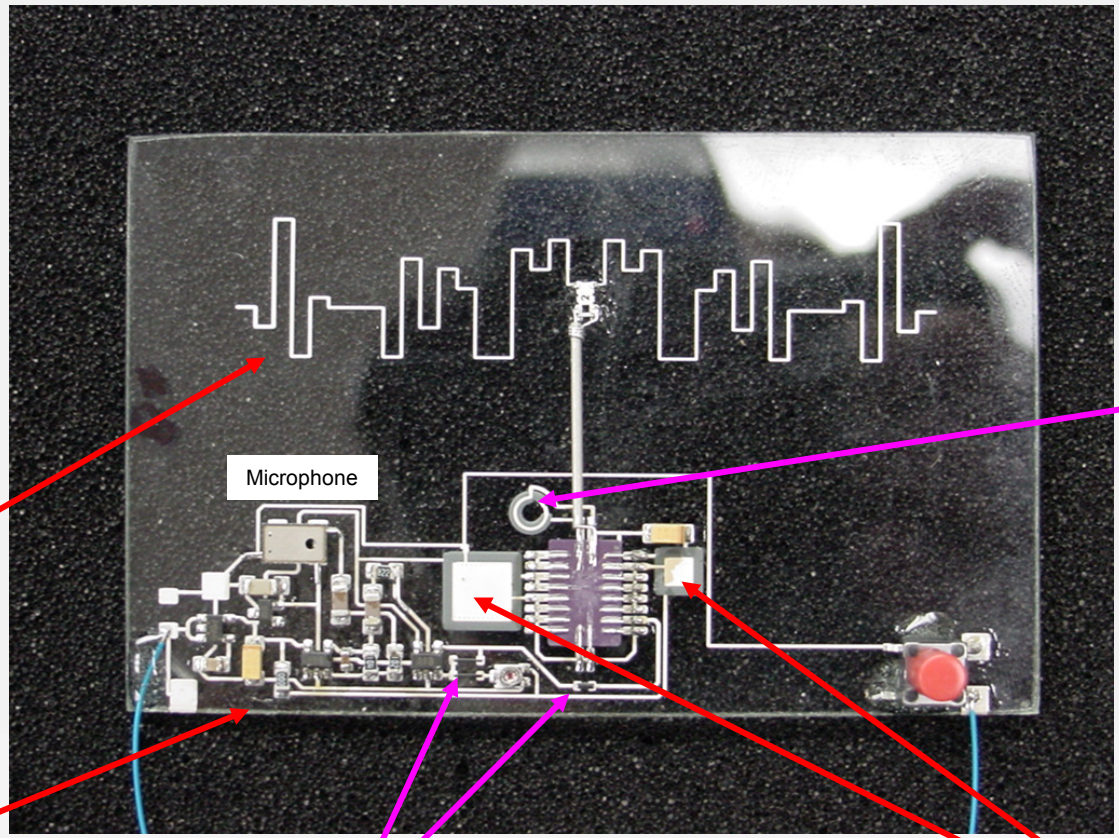


Inductors

Using engineered materials with nano and micro particles, flakes and rods….it is now possible to print quality passives.

The “Raw” materials are conductive, dielectrics and magnetic in their base characteristics. The ability to print any material in any shape on any substrate, has allowed the necessity for solder to be greatly diminished.

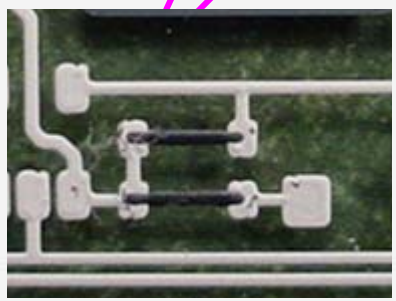
Directly-Written Transmitter Components



916MHz, 50Ω
Stochastic Dipole
50% size reduction

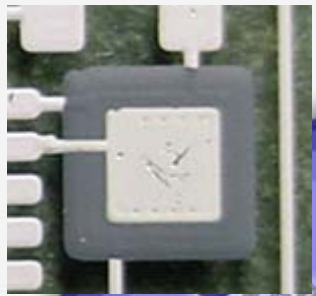
Parallel Resonant
LC network (ESD shunt)

"WCB"
Written Circuit Board
Sintered silver particles
on glass



20K resistors (two-left)
3K resistor (right)

Multi-leaded Capacitors
100pF capacitor (left)
25pF capacitor (right)



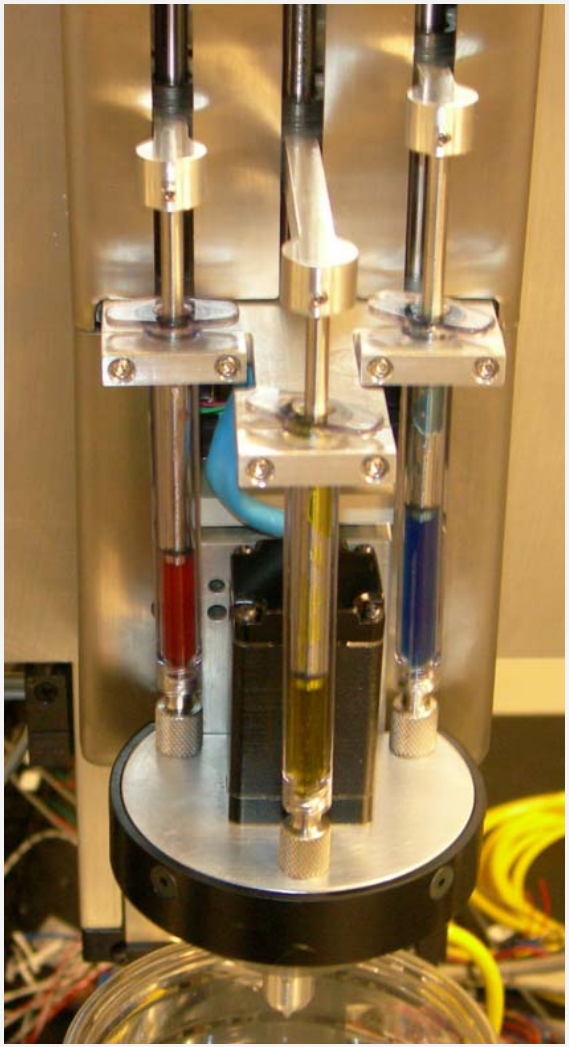
Component Mixing System

- Required for multi-component process on the manufacturing floor.
- Applications: Spontaneously forming polymers, multi-part epoxy, bio-polymers, etc.
- Requirements: Small mixing volume, short residence time, homogeneous mixing

Passive vs. Active Mixing

- Passive mixing
  - Simple
  - No limit on inlet components
  - Difficult to reach homogeneity
- Active Mixing
  - Requires mixing “spoon”
  - Inlet number dependent on “mixing bowl” size
  - Easier to reach homogeneous mixing

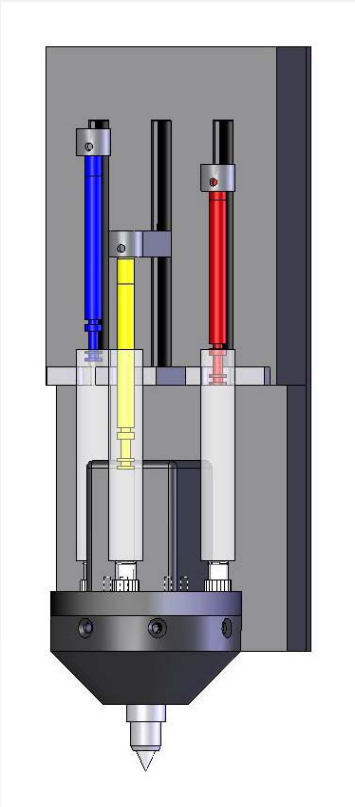
Three Component Active Mixing System



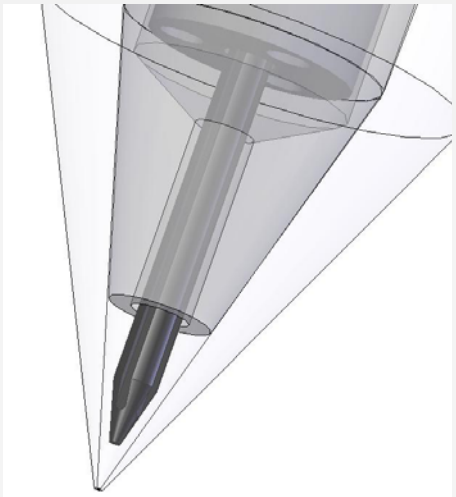
Three independently controlled linear actuators displace material into tip, which acts as “mixing bowl”

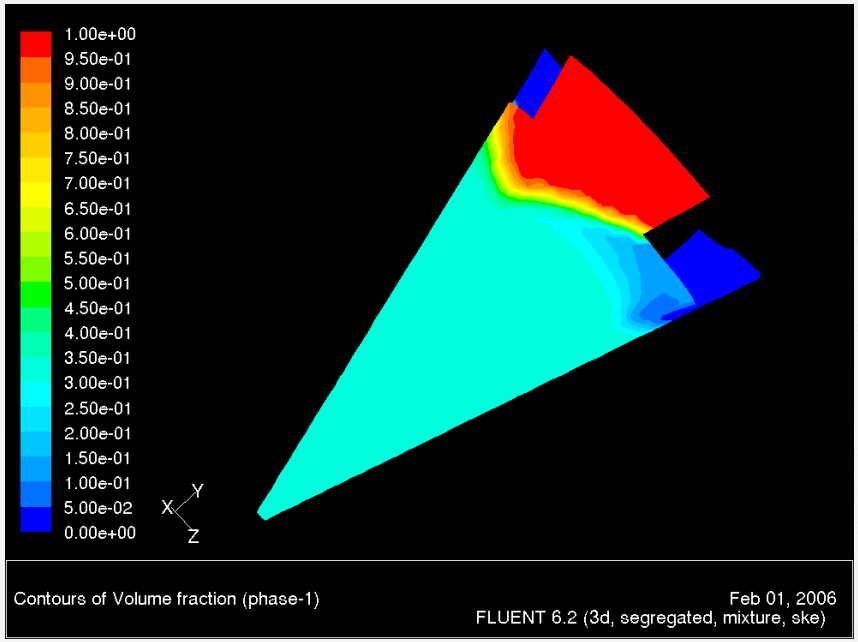
Material is actively mixed by 800 micron stainless steel fluted rod, which acts as “mixing spoon”

Small Mixing Area Allows Material Control

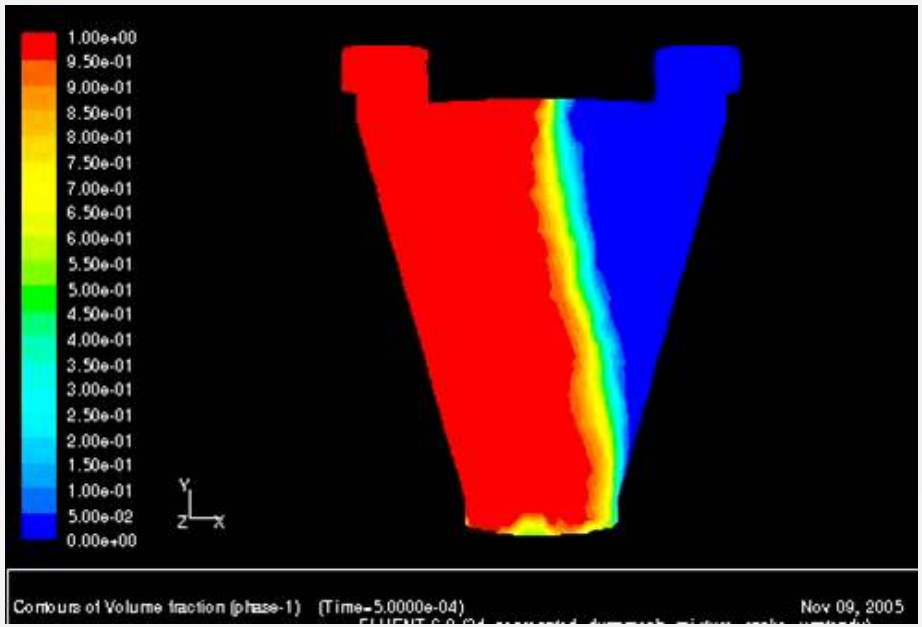


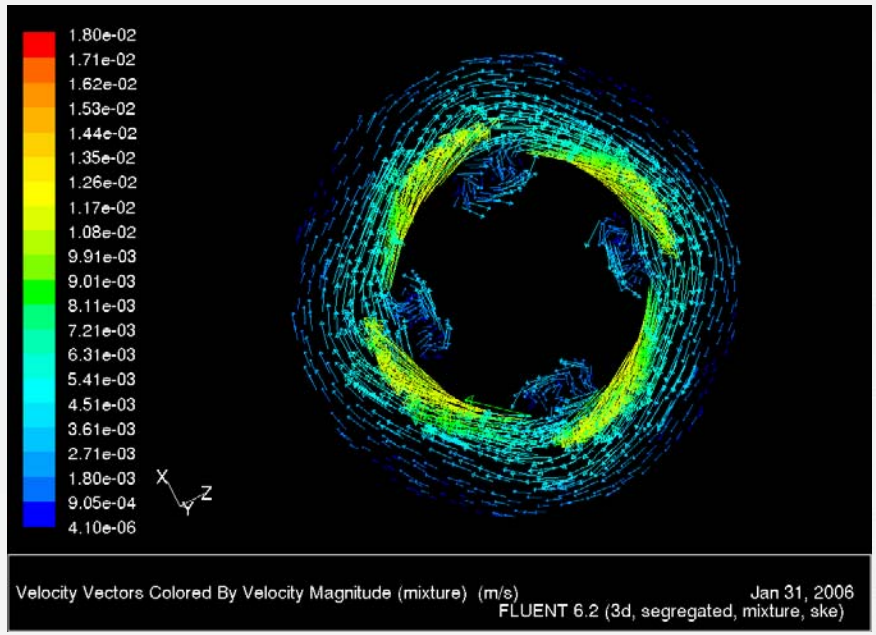
Material is mixed by rotating rod and close clearance internal wall resulting in homogeneous mixing



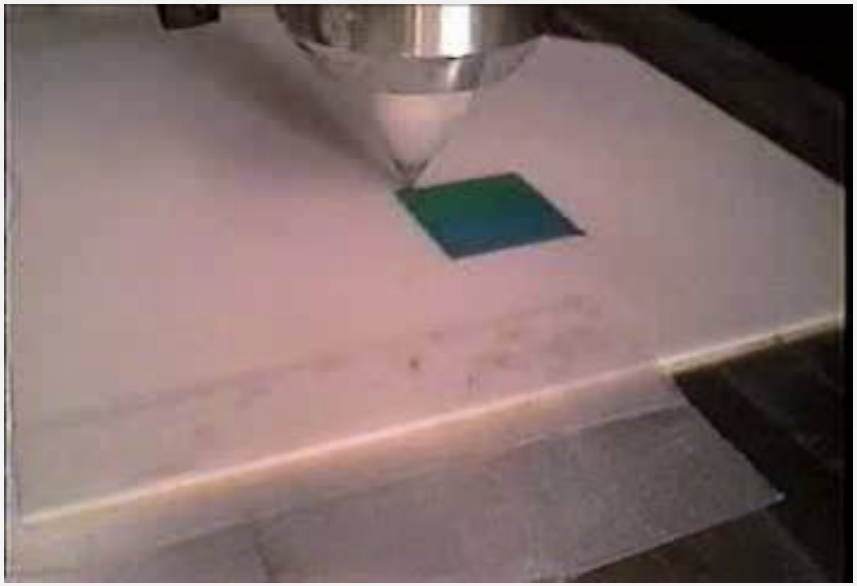


Modeling to ensure correct flow patterns

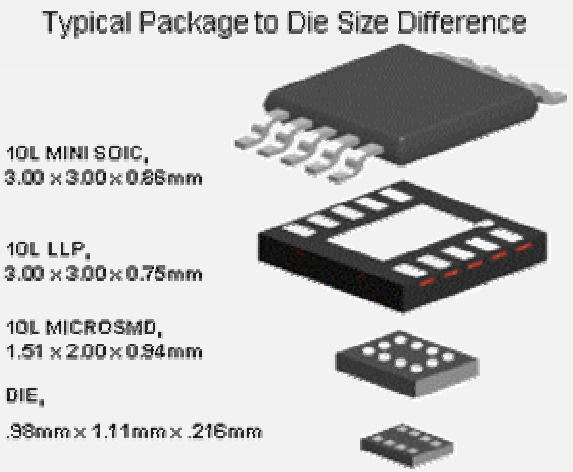




Results

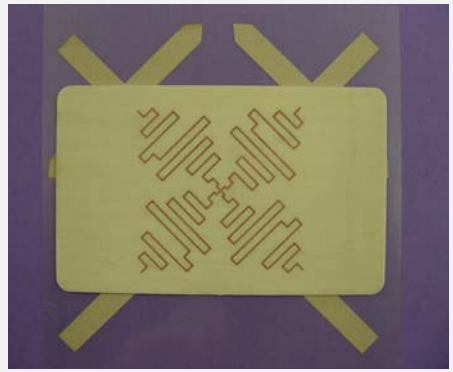


The Vision



A 50 times volume compression!

Passives from a tube or multiple tubes!



Compressed Antennas!

Design electrical circuit

Scan object to serve as substrate or input from CAD

Evolutionary Optimizer
"Wraps" circuit around object

Electronic Printer, Prints Circuit Conformally

Print working electronic circuits on any surface……