

3D Printed Electronics and Aerosol Jet Systems

Electrical Engineering and Computer Science

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New Course Announcement

- Dr. Lili Dong and her students have developed a new lab course EEC492/MCE493: Electronic Printing Lab, which is to be offered in spring 2016.

AEROSOL JET 200



Aerosol Jet Technology

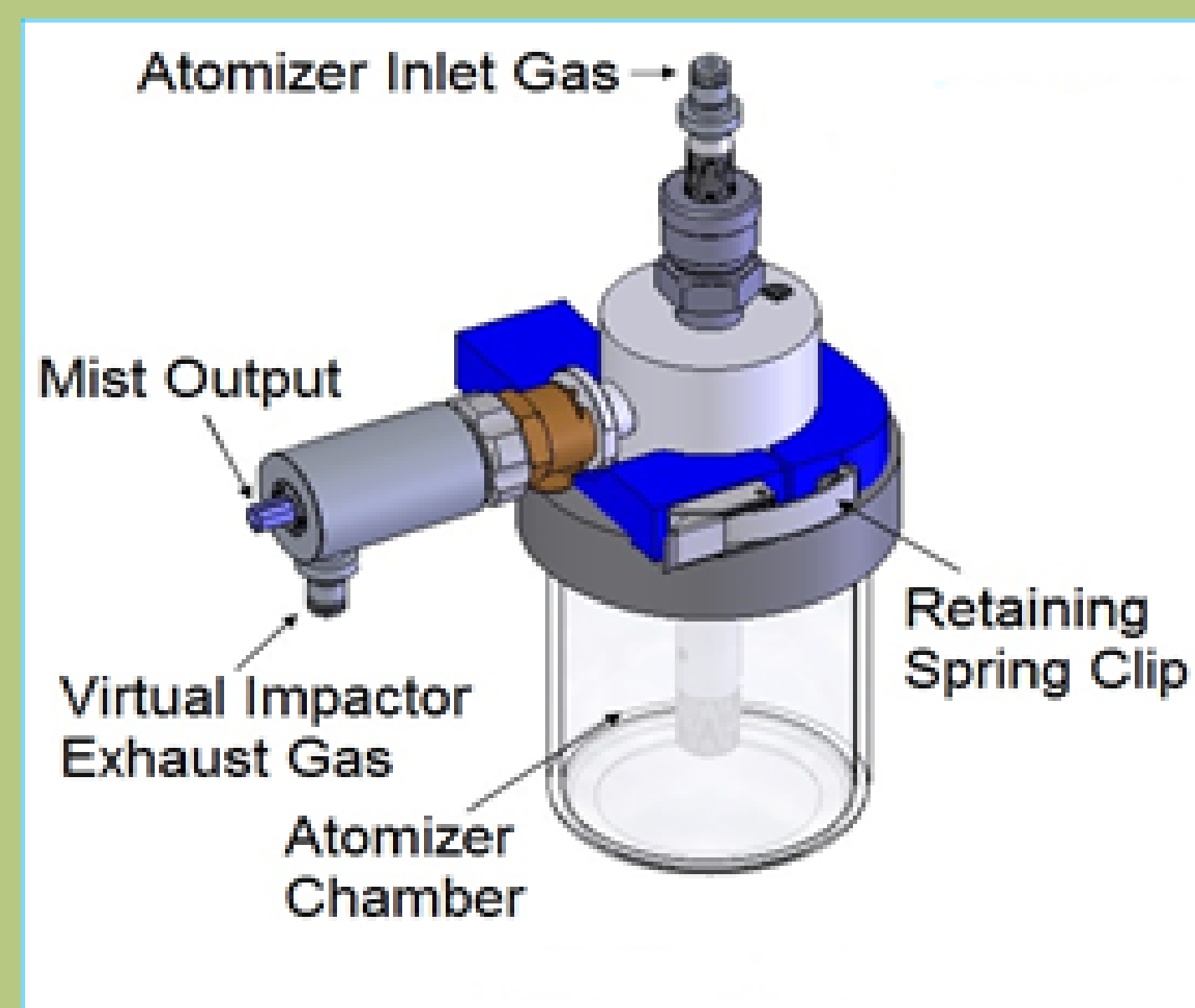
- The Aerosol Jet process uses **aerodynamics** to deposit aerosolized materials onto substrates.
- The process is an **additive**, direct-write printing technology eliminating the need for lithographic or vacuum deposition techniques.
- Materials include **metallic inks**, nanoparticles, pastes, and biological materials.
- **Layer** wise deposition of inks makes the printing process three dimensional.
- Features can be deposited with linewidths as small as **10 microns**.

Aerosol Jet Systems : Capabilities

- Aerosol Jet Systems uses **KEWA** software package for process, Motion and vision controls.
- Capable of both **manual** and **auto** path processing.
- Design can be done in **AutoCAD** or **EAGLE** software.
- VMTools software converts all design files in required format.
- Dual **microscopic cameras** allow to monitor the printing process.
- Pressured **gas** is used to drive all the movable atoms from place to place.
- Micro Oven **curing** is compulsory for all inks printed.
- Curing **temperature** and **time** depend on the inks utilized.
- Printer and its parts need to be **maintained** before and after printing.

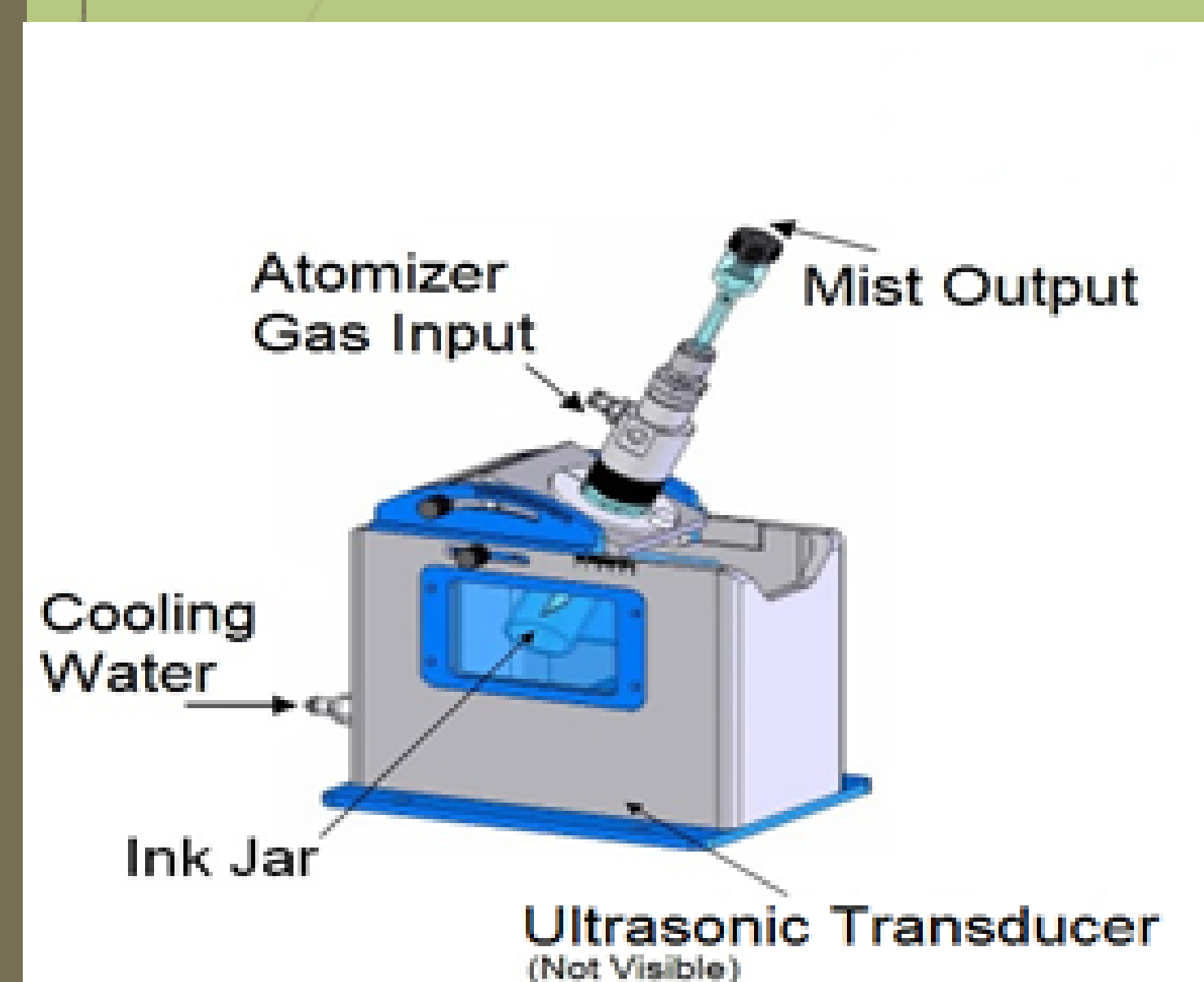
Pneumatic Atomization Process

- The Pneumatic uses a high-velocity gas stream to break the liquid stream into droplets.
- The droplets are pushed into a **virtual impactor**.
- The virtual impactor removes the atoms which don't have the **necessary diameters**.
- The atom particles which are good enough to be used will be driven to **print head** and eventually onto the **substrate**.
- The inks with a viscosity up to **1000 centipoise** and particle sizes up to **500nm**.
- Typical inks are **metal ink**, epoxy, PTF paste, ceramics etc.



Ultrasonic Atomization Process

- The Ultrasonic Atomizer produces high-frequency **pressure waves** to atomize liquid ink into atoms.



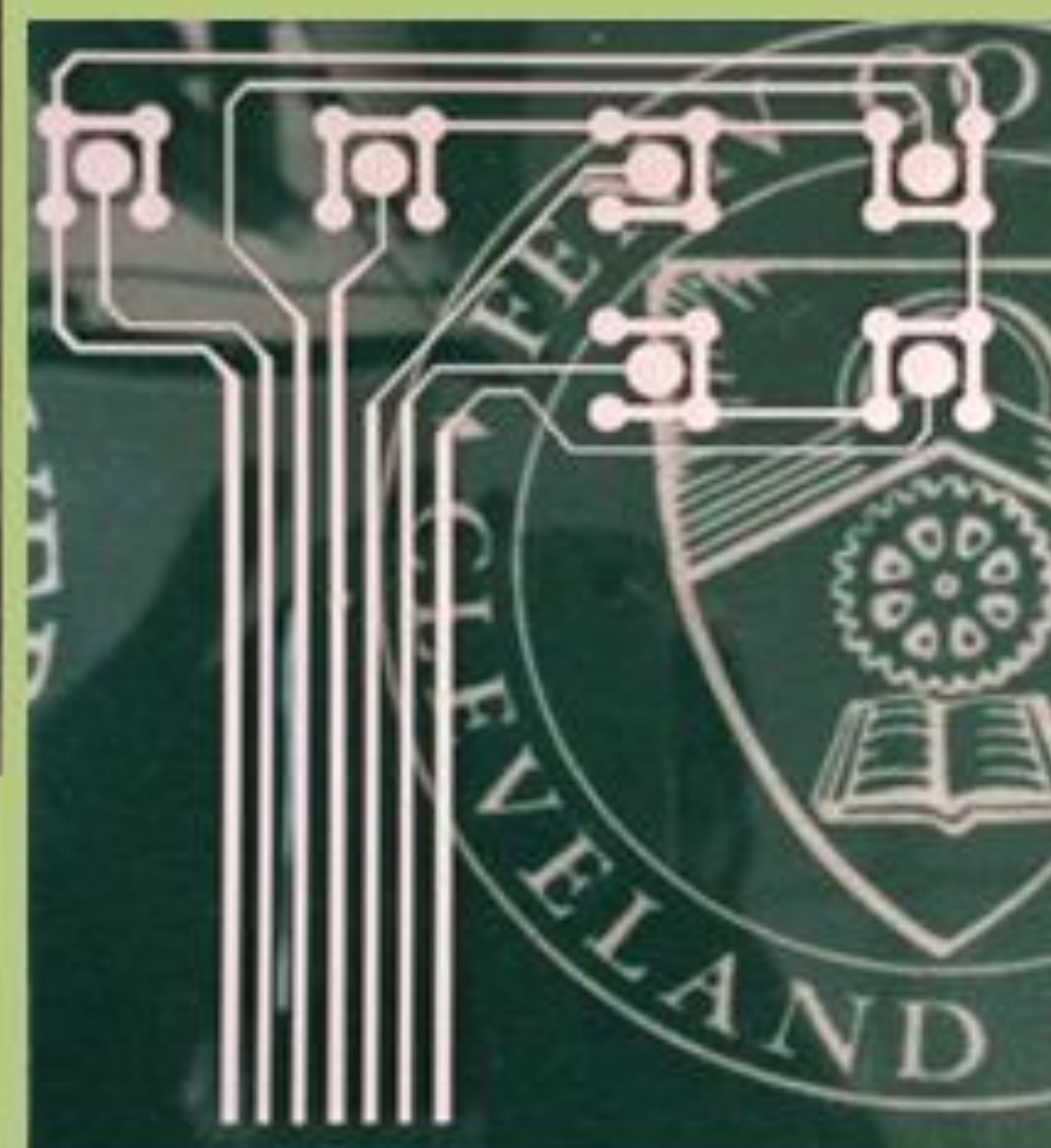
- The atomized particles are driven into a **gas stream** and induced into the **print head**.
- The inks can be with a viscosity of up to **5 centipoise**, and the particle sizes can be up to about **50nm**.
- Typical inks are aqueous inks (acids, bases, CNT dispersions, conductive polymer), **organic semiconductors**, metal nanoparticle inks etc.

Applications : Industrial

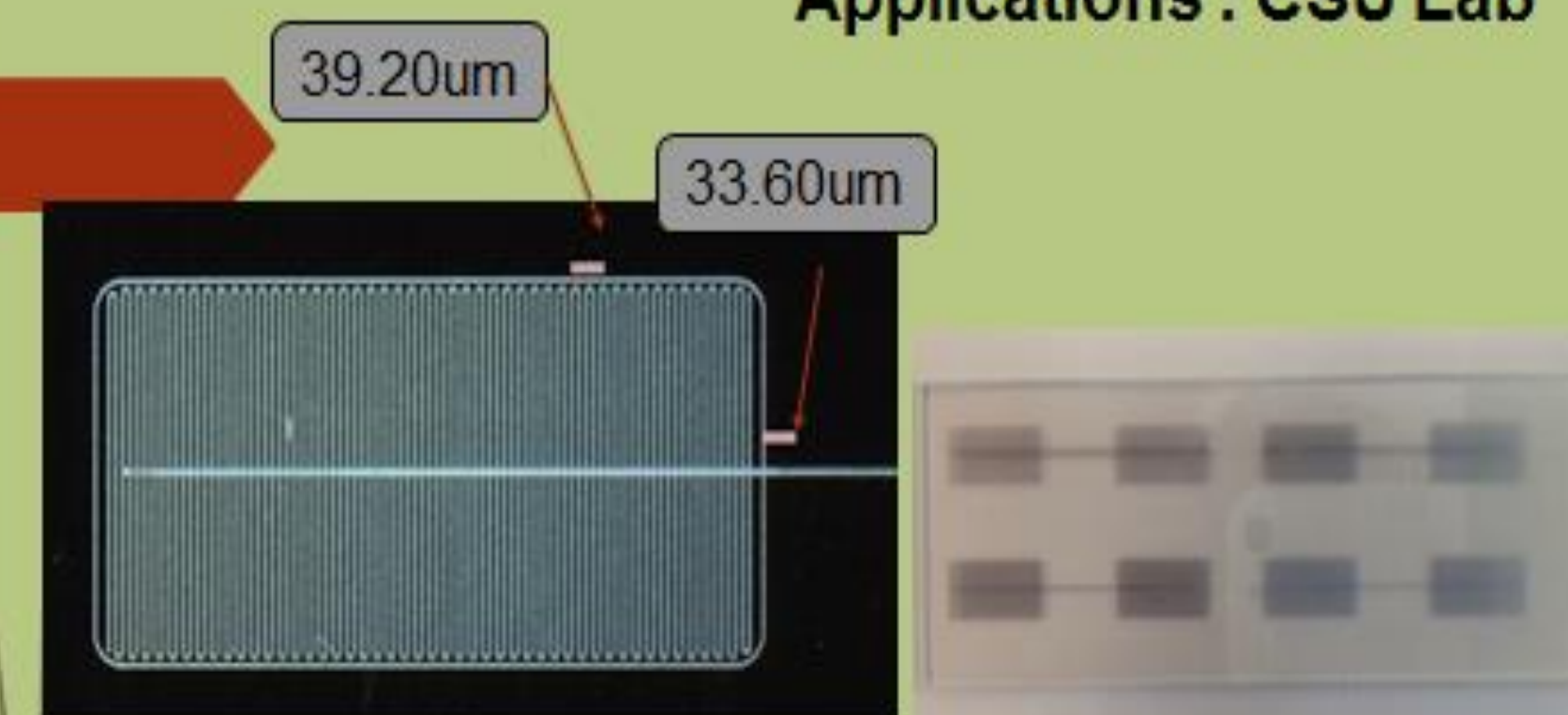


Left picture: Lighting circuit for Lumitex

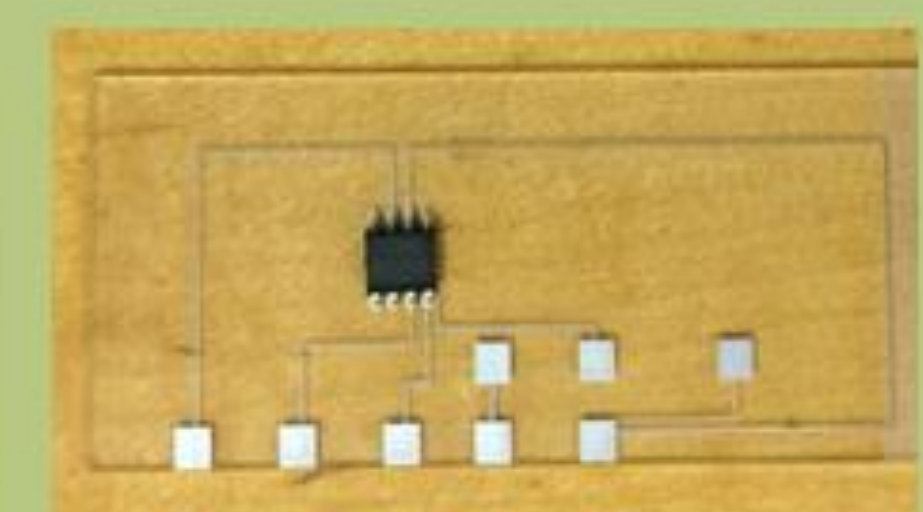
Right picture: Circuit in switching membrane for Cubbison



Applications : CSU Lab



Microscopic view Overview
Conducting Pads



Non Inverting Amplifier circuit

- In process of **multiple layer** printing and testing, a dielectric layer is printed in-between two conducting layers.
- **Silver epoxy** has been used for surface mounting chips.
- **Resistors** can be printed using resistive ink.



CSU logo printed using AJ 200