Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office

TOP3–00194

Acoustic Micro-Dispensing

Technology

A method for dispensing microscopic volumes of liquid has been developed. The droplet volumes are measured in picoliters.

Benefits

- Has no nozzles to clog or limit drop size
- Operates on demand
- Does not require any high-pressure systems
- Works under vacuum and at high temperatures
- Is suitable for conveyorized production
- Precisely controls size (between 25 and 250 μm)
- Is chemically compatible with a wide variety of harsh liquids

Microdroplet dispensing
- – Controls droplet size electronically
- – Controls droplet ejection velocity electronically
- – Ejects each droplet on demand
- – Can eject hot, dense liquid metals

Microfountain dispensing
- – Controls contact on command
- – Operates from a liquid pool
- – Can be used individually or in arrays
- – Can process small unmasked areas
- – Works with process liquids too viscous to be ejected as drops

Commercial Applications

- Precise dispensing of liquid coatings, adhesives, inks, and slurries
- Maskless deposition and etching
- Precise placement of solder bumps and balls

Technology Description

Acoustic micro-dispensing uses acoustic radiation pressure to either eject droplets or form a low-velocity liquid fountain (fig. 1). A transducer emits bursts of ultrasonic waves. Then, a focusing lens transmits the waves to the surface of a liquid pool, creating a radiation pressure zone. The pressure causes the liquid to rise and form droplets.

The size of the zone is proportional to the acoustic wavelength, and the drop size is proportional to the pressure zone, so drop size is controlled by frequency. Velocity can be controlled by amplitude and burst duration. Drop placement can match the accuracy of an inkjet printer. In addition, the ejection of hot liquid solder droplets has been demonstrated in a high vacuum (fig. 2).

Microdroplet and microfountain dispensing overcome the limitations of small high-pressure nozzles and are clog free. The process has a number of variables that can be controlled independently, and it can be readily integrated with a computer control system. Etching and plating can be improved with microfountains because they create localized process zones that may eliminate the need for masking.

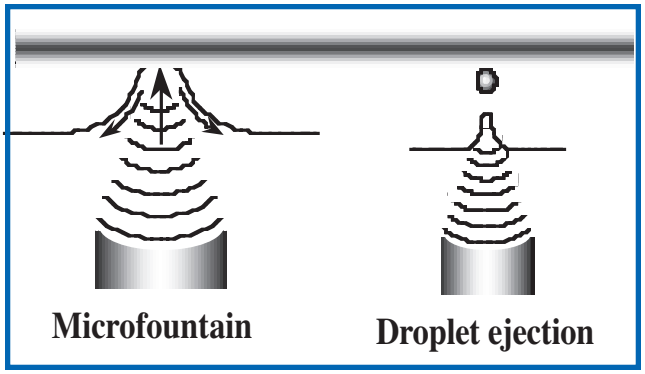

Figure 1.—Micro-dispensing.

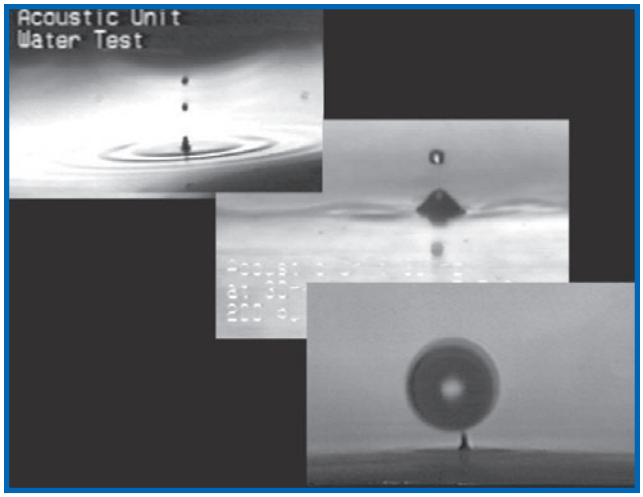

Figure 2.—Droplet ejection.

Options for Commercialization

- Two U.S. patents are available for licensing.

NASA Glenn is seeking potential users with specific applications. Additional research and development are required to build a technology demonstrator for specific applications. Partnerships are anticipated with the electronics, microelectronics, and microelectromechanical systems (MEMS) industries.

Contact

Technology Transfer & Partnership Office
NASA John H. Glenn Research Center
at Lewis Field
Mail Stop 4–2
Cleveland, OH 44135–3191
Phone: 216–433–3484
Fax: 216–433–5012
E-mail: ttp@grc.nasa.gov
http://technology.grc.nasa.gov

References

U.S. Patent 5,520,715; 5,722,479; 5,549,237; 6,003,388; 6,029,518; 6,368,482

Key Words

Microsystems

MEMS

Acoustic radiation pressure

Ultrasonic

Micro-dispensing

Directional electrostatic accretion process