A pocket-size ultrasonic nebulizer employing a novel nozzle improves inhalers

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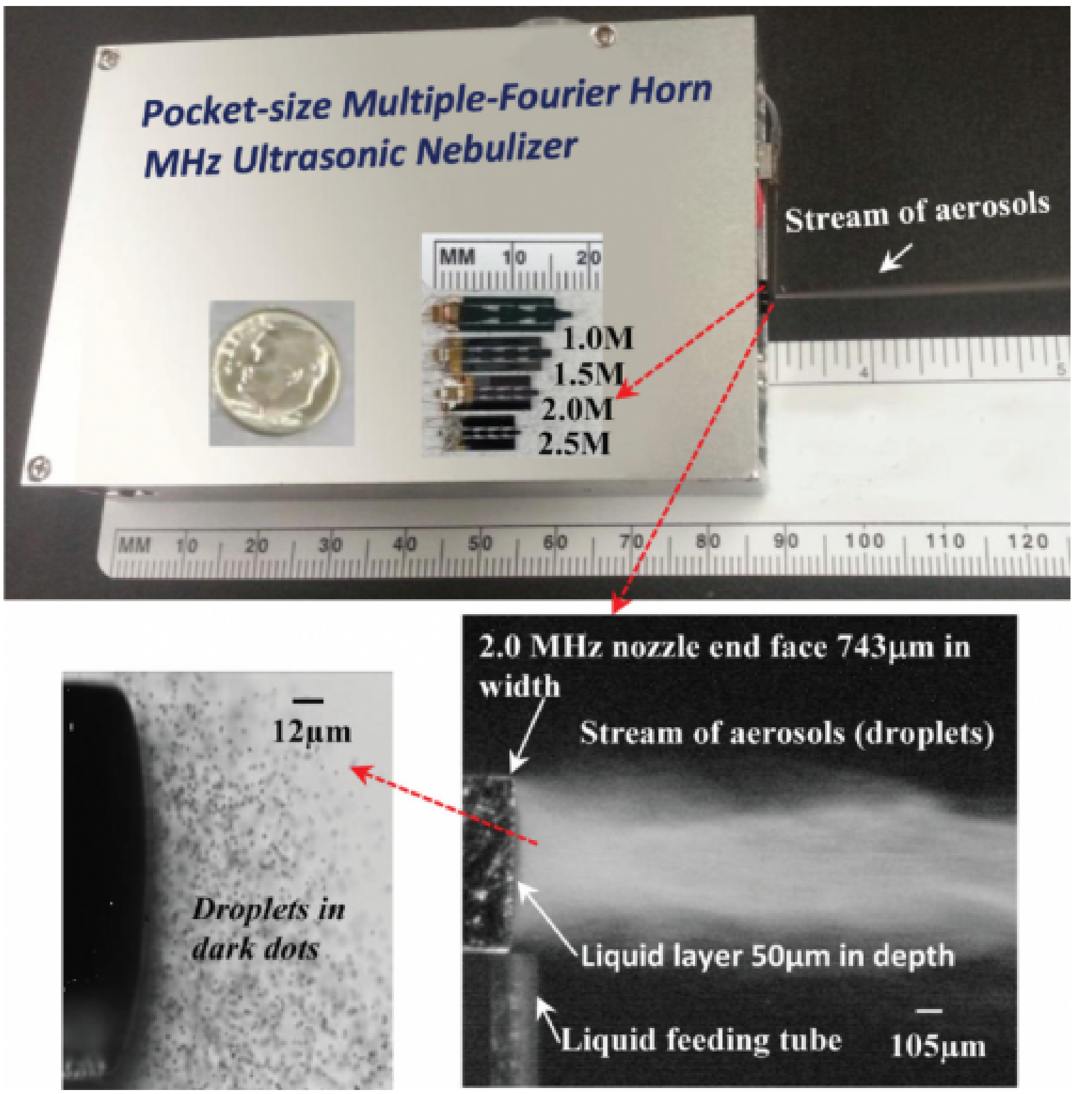

This is a pocket-size ultrasonic nebulizer with insets: (Top) Nebulizer and MEMS-fabricated MHz nozzles laid on its cover. (Bottom) Aerosols ejected from the medicinal liquid layer resting on the end face of the nozzle tip: (L) Individual aerosols imaged using a high-speed camera (104 frame/sec) with short depth of focus at output rate of 40μL/min with 1.0 MHz nozzle, and (R) CCD image (20 frame/ sec) of aerosol stream at output rate of 350μL/min and electrical drive power of 0.27 W with 2.0 MHz nozzle. Note that the scale bars in (L) and (R) are 12 μm and 105 μm, respectively. Credit: Technology journal.

Inhalation is an increasingly important route for non-invasive drug delivery for both systemic and local applications. Control of particle size and output plays a critical role in the efficient and effective delivery of oft en expensive medications to the lung. Drugs designed to treat pulmonary diseases or for systemic absorption through the alveolar capillary bed require optimum particle sizes (1 to 6 μm) for effective delivery.

A team of researchers from the Department of Electrical Engineering and Computer Science at the University of California, Irvine has realized a novel device for inhalation drug delivery, which is capable of fulfilling needs unmet by current commercial devices. The precise control of particle size and much narrower particle size distribution achieved by the new device will improve targeting of treatment within the respiratory tract and improve delivery efficiency, resulting in better efficacy, fewer side effects, shorter treatment times, and lower medication costs compared with existing nebulizers. The core of the new delivery device is a centimeter-size clog-free silicon-based ultrasonic nozzle with multiple Fourier horns in resonance at megahertz (MHz) frequency. The dramatic resonance effect among the multiple horns and high growth rate of the MHz Faraday waves excited on a medicinal liquid layer together facilitate ejection of monodisperse droplets of desirable size range (2-5 μm) at low electrical drive power (

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