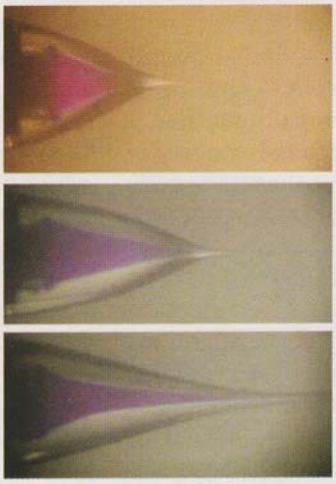
Thin Jet Flies Two for One

Double streams yield sheathed nanoballs, fibers

Powerful electric fields can stretch liquids into narrow jets that burst into sprays of droplets. This phenomenon has revolutionized mass spectrometry, a technique for weighing a sample's constituent atoms and molecules. Meanwhile, some industries are testing the technique, known as electrospray, for such uses as making and delivering drugs.

Researchers in Spain and the United States have now applied electrospray principles in a novel way, creating ultrathin liquid jets in which a stream of one liquid encloses a stream of another. When such a coaxial jet breaks up, it produces exceptionally tiny, coated droplets. Or, if the coaxial flow is allowed to quickly solidify, the technique yields coated fibers.



GETTING THE POINT
Stretched into a cone by an electric field, a jet of two fluids—ethylene glycol (pink or purple) inside a clear polymer—elongates as the flow rate of the liquids increases (top to bottom).

Whether particles or fibers, the products are uniform in size, coating thickness, and other structural characteristics, says Ignacio González Loscertales of the University of Málaga in Spain. Potential uses of the products range from encapsulated drugs and food additives, such as flavors and aromas, to insulated nanometer-scale wires for ultrasmall electronic circuits (*SN: 2/9/02, p. 83*).

"It's a very promising technique," comments Jan C.M. Marijnissen of the Technical University of Delft in the Netherlands.

To make the coaxial jets, Loscertales and his coworkers use hollow needles up to a millimeter in diameter. The needles are nested to create concentric nozzles from which different liquids can flow. At least one of the fluids has to be electrically conductive for the technique to work.

Simply pumping immiscible liquids through such nozzles creates a coaxial flow that's as wide across as the largest needle, Loscertales explains. When the researchers apply a strong electric field, the two-liquid flow narrows into a superthin jet.

In the March 1 *Science*, the researchers report making droplets—only 150 nanometers in diameter—of salt water coated with olive oil, and vice versa. By using an outer polymer that solidifies under ultraviolet radiation, they also fabricated hard-coated balls containing liquid ethylene glycol. Another team at the University of Nebraska in Lincoln is adapting the method for making nanofibers. —P. WEISS