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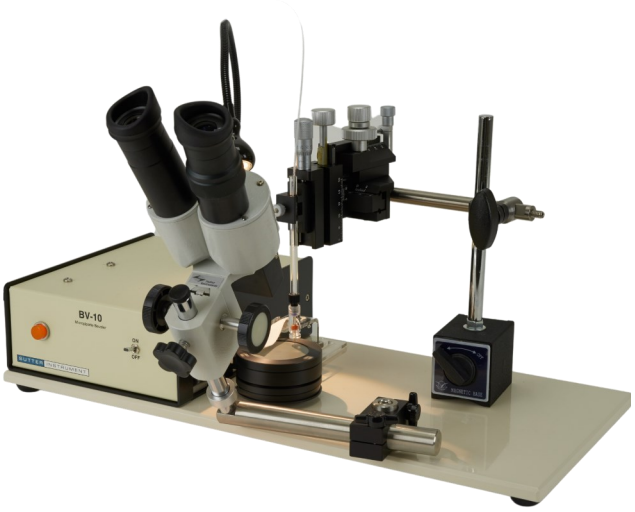
TECH NOTES



Use of the BV-10N for Fabrication of Nano Electrospray Ionization Emitters

The BV-10N is a new configuration of Sutter Instrument's micropipette beveler designed to polish nanoESI emitters generated using the P2000/F laser-based micropipette puller. Using the BV-10N alongside the P2000/F gives investigators access to a wider range of emitter inner diameters than when using the P2000/F alone. This is because fundamental physical properties of the fused silica tubing and mechanical properties of the puller itself preclude glass separation at tip inner diameters greater than approximately 1/10th the inner diameter of the starting material. That is, the largest tip one could reasonably expect to fabricate from 360 um OD x 20 um ID tubing has an inner diameter of 2 um. In the past, these limits were overcome by commercial manufacturers of nanoESI emitters using hydrofluoric acid (HF) to dissolve excess glass, effectively etching back the tip to any desired ID while also reducing the OD, thus limiting the surface area of glass that ionized samples may interact with as they are ejected from the emitter. Recently, the major supplier of HF-etched emitters stopped producing them for commercial sale. Many investigators have contacted us expressing interest in these emitters, but because of the dangers associated with the use of HF neither we at Sutter Instrument nor many investigators have been able to replicate the HF etching process.

In lieu of HF etching, we have developed the BV-10N based on our time-tested micropipette beveler technology. The concept is simple: a range of tip inner diameters can be achieved by breaking the tip of a pulled emitter at a particular point. However, these breaks are not clean and leave much glass which may interfere with the experiment. The BV-10N is used to polish this break to an almost perfectly smooth surface, improving emitter performance. Notably, this approach cannot achieve walls at the aperture as thin as those in HF-etched emitters, but through clever programming on the P2000/F the starting OD:ID ratio can be greatly reduced. Some examples are given in the table below:

Starting OD (µm)	Starting ID (µm)	Starting OD:ID Ratio	Target Tip ID (µm)	OD at target ID (µm)	Final OD:ID ratio
360	100	3.6	30	60	2
360	75	4.8	25	75	3
360	50	7.2	20	80	4
360	20	18	10	90	9

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Operation of the BV-10N is straightforward: Simply load the broken emitter into the provided pipette holder. Inject some air through the emitter to keep fluid out as you grind the surface. Finally, grind the emitter to a smooth polish using the coarse and fine griding plates. If any debris accumulates in the emitter during this process, it can be removed by aspirating and ejecting a small volume of 1N nitric acid.

With practice, this whole process, from pulling to completion, takes less than 10 minutes per emitter and produces consistent emitters with your desired geometry.

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