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Note

Simple device for flushing capillaries in capillary zone electrophoresis

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In order to obtain good separations in capillary zone electrophoresis, the capillaries in which the separations occur must have a high ratio of length to inside diameter; typically they have inside diameters of 50–100 μm and their length is between 30 and 100 cm[1,2]. Supplies of such capillaries include Microphoretic Systems (Sunnyvale CA, U.S.A.), Applied Biosystems (Foster City, CA, U.S.A.), Bio-Rad Labs. (Richmond, CA, U.S.A.) (HPE 100), Beckman (Palo Alto, CA, U.S.A.) and Dionex (Sunnyvale, CA, U.S.A.). Consequently, these capillaries display a high hydrodynamic resistance and require high pressure for their filling or washing. Periodic washing is particularly important when working with surface-untreated silica capillaries, which at neutral pH have a tendency to bind negatively charged solutes owing to their own positive surface charge[3]. Therefore, surface-treated capillaries are gaining in popularity, but their preparation requires pumping of the surface modifier, frequently for a fairly long period of time[4].

The fluid volume flowing laminarly through a cylindrical tube is given by

$$V = \frac{\pi r^4 p t}{8 l \eta} \tag{1}$$

where V = volume, r = inside radius of the tube, p = pressure, l = length of the tube, η = dynamic viscosity and t = time.

To exchange the content of the capullary, a volume V_c has to pass through it:

$$V_c = \pi r^2 l \tag{2}$$

The pressure that must be applied to exchange the content of the capillary within time t can be calculated by combining eqns. 1 and 2:

$$p = V_c \cdot \frac{8 l \eta}{\pi r^4 t} = \frac{8 l^2 \eta}{r^2 t} \tag{3}$$

Assuming that (i) the flow is laminar, (ii) the dynamic viscosity of the passing fluid equals that of water at 20°C, (iii) the length of the capillary is 60 cm and (iv) the exchange time should be 10 s, the numerical solution of eqn. 3 for different inside diameters is p = 115.2, 204.8 and 460.8 kPa for I.D. 100, 75 and 50 μm, respectively.

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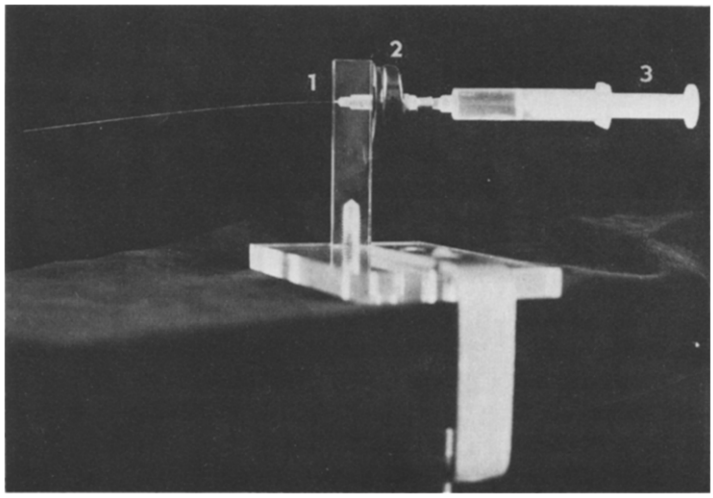

Fig. 1. Overall view of the flushing device. 1 = Hole for inserting the capillary; 2 = tightening knob; 3 = syringe.

These relatively high pressures require a tight connection of the capillary to the filling or washing device, *i.e.*, either a syringe or a high-pressure pump. Connection and disconnection of the capillary must be easy without the risk of breaking or damaging the delicate capillaries.

To accelerate and simplify the manipulations during washing of the capillaries, we have constructed the simple equipment shown in Fig. 1. The capillary is inserted from the left-hand side into a 0.4-mm I.D. opening and tightened by turning the tightening button on the right-hand side half a turn clockwise. Then the pressure is applied through the syringe as shown or, when connected to a high-pressure pump, the pump is started.

Fig. 2 shows details of the tightening part in cross-section. By turning the screw 2 (attached to the tightening button) in the Perspex body 1, the piston part at the end of

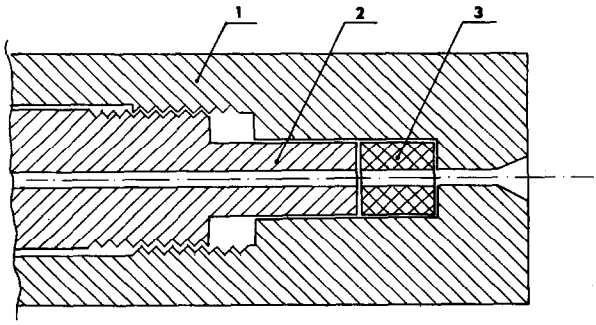

Fig. 2. Cross-sectional view of the device. 1 = Perspex body; 2 = elastic (silicone-rubber) insertion; 3 = screw with central bore.

the screw moves towards the elastic insertion 3, made of silicone rubber. Hence the space for this insertion diminishes and the mass escapes into the central hole (through which the flushed capillary is passing), thus closing the capillary very tightly in the silicone-rubber insertion. A conical orifice in the Perspex body facilitates insertion of the capillary into the device.

REFERENCES

1 B. L. Karger, A. S. Cohen and A. Guttman, *J. Chromatogr.*, 492 (1989) 585.
2 J. W. Jorgenson and K. De Arman-Lukacs, *Science (Washington, D.C.)*, 222 (1983) 226.
3 H. H. Cauer and D. McMangill, *Anal. Chem.*, 58 (1986) 166.
4 G. J. M. Bruin, R. Huisden, J. C. Kraak and H. Poppe, *J. Chromatogr.*, 480 (1989) 339.