Abstract

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Project Title: Ultrathin-layer Chromatography Using an Electrospun Polyacrylonitrile Stationary Phase

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Research in the miniaturization of planar chromatography led to various approaches in manufacturing ultrathin-layer chromatography (UTLC) layers of reduced thickness (<50 _m) along with smaller instrumentation, as targeted in Office Chromatography. This novel concept merges 3D print & media technologies with miniaturized planar chromatography to realize an all-in-one instrument, in which all steps of UTLC are automated and integrated in the same tiny device. In this context, the development of electrospun polyacrylonitrile (PAN) nanofiber phases was investigated as well as its performance. A nanofibrous stationary phase with fiber diameters of 150–225 nm and a thickness of ca. 25 µm was manufactured. Mixtures of water-soluble food dyes were printed on it using a modified office printer, and successfully separated to illustrate the capabilities of such UTLCmedia. The separation took 8 min for 30 mm and was faster (up to a factor of 2) than on particulate layers. The mean hRF values ranging from25 to 90 for the five food dyes were well spread over themigration distance, with an overall reproducibility of 7%(mean %RSD over 5 different plates for 5 dyes). The individualmean plate numbers over 5 plates ranged between 8286 and 22,885 (mean of 11,722 over all 5 dyes). The singlemean resolutions RS were between 1.7 and 6.5 (for the 5 food dyes over 5 plates), with highly satisfying reproducibilities (0.3 as mean deviation of RS). Using videodensitometry, different amounts separated in parallel led to reliable linear calibrations for each dye (sdv of 3.1–9.1% for peak heights and 2.4–9.3% for peak areas). Coupling to mass spectrometry via an elution head-based interface was successfully demonstrated for such ultrathin layers, showing several advantages such as a reduced cleaning process and aminimum zone distance. All these results underline the potential of electrospun nanofibrous phases to succeed as affordable stationary phase for quantitative UTLC.

Keywords: nanomaterials; mass spectrometry; planar chromatography