In situ Concentration Monotoring of MFI Zeolite Membranes by Step-Scan Photoacoustic Spectroscopy

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We report the first spatially resolved, quantitative, non-destructive, in situ, measurements of the transport of organic molecules through a polycrystalline, anisotropic, nanoporous molecular sieve membrane, with micron-scale resolution. The knowledge of membrane composition (including guest molecules) and transport properties as a function of depth is of prime interest. Quantitative methods for probing cross-sectional structure (e.g., electron microscopy, energy-dispersive X-ray analysis, and confocal microscopy) are destructive and/or ex situ. Methods for studying membrane transport phenomena depend heavily on theoretical models (e.g., the Maxwell-Stefan equations), since the transmembrane flux is the only experimental information available. We have developed an experimental method based on step scan photoacoustic spectroscopy (SS-PAS) and the requisite data analysis techniques for this purpose. An important application is the transport-model-independent experimental description of membrane transport, by simultaneous measurement of the concentration profile, membrane thickness and membrane flux.