Solubility Interactions between Organic Vapors and Specific Polymeric Claddings for Optical Fiber Sensor

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Five polymeric materials (heteropolysiloxanes) have been exposed to a number of compounds, heptane, water, ethanol, toluene, dichloromethane and carbon tetrachloride, and are used as claddings of an optical fiber sensor. From the output signal of the sensor, the distribution coefficient K of the different compounds was estimated. The solubility of the analytes depends on the boiling temperature for a family, as has been confirmed for a series of aromatic compounds. The dispersion parameters l of the different polymeric materials were calculated through the detection of heptane. They follow the sequence PMOS > PMHS > IBS > GPMDMS > VMPMS. It has been shown that the dispersion interactions can describe the solubility interactions of toluene and carbon tetrachloride with the five polymeric materials, whereas the solubility interactions of water, ethanol and dichloromethane cannot be described by dispersion interactions. The lowest detection limits were obtained with PMOS (polymethyloctyl siloxane) for heptane and toluene; they were, respectively, 0.02% and 0.008%.

1.   Introduction

Specific polymeric films applied to optical sensors have been the subject of intensive research and development during the last few years.[1,2] In the area of vapor detection, by