EMFI FILM AS A PHOTOACOUSTIC DETECTOR

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Photoacoustic spectroscopy (PAS) is based on the conversion of light to acoustic waves via absorption and local thermal relaxation. Recent progress of lasers and sensitive microphones make it one of the most sensitive gas analysis tools. The other benefits of PAS are zero background signal and simple implementation of detector. Sensitivity of the detector depends on light intensity and performance of applied acoustic pick-up. Conventional microphone design has been a tradeoff between size (sensitivity) and bandwidth but now a novel material shows promising features with respect to this problem.

Electromechanical film (EMFi) is a thin, typically 30–70 µm, cellular polypropylene film that exhibits quasi-piezoelectric properties. The cellular structure is achieved by stretching the polypropylene during manufacturing process after which the film is charged with corona charging. Finishing is made by metalizing both sides to attain better impedance matching to ambient gas. The result is a space charge electret that can be used in various sensor and actuator applications. Nowadays many commercial applications from keyboards to flat loudspeakers are based on EMFi material [1].

EMFi’s advantage over most electrets is formability combined with relatively high piezoelectric coefficient \(d_{33} = 170\) pC/N [1]. This among good adoption to air makes the material ideal for picking up acoustic signal inside photoacoustic cell. In this work the measured detection limit of the developed PA detector is 180 ppb of NO\(_2\) in nitrogen. Sensitivity can be enhanced by stacking EMFi foils together. With special \(N_2\) treatment in the manufacturing process, the \(d_{33}\) coefficient increases up to 790 pC/N [2]. The most intriguing property of EMFi is flexibility which enables whole new kind of PA cell designs to be implemented.
