

**Title** A compact optical multichannel system for ethylene monitoring

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**Citation** *Microsystem Technologies*, 14, Numbers 4-5, 637-644, 2008

**Keywords**

### **Abstract**

Precise and continuous ethylene detection is needed in various fruit ripening applications. The aim of this work is the development of a miniaturised mid-infrared filter spectrometer for ethylene detection at 10.6  $\mu\text{m}$  wavelength. For this reason optical components and signal processing electronics were developed, tested and integrated in a compact measurement system. The main optical components, their integration of the optical system, as well as a description of the developed electronics and the first results of gas measurements are described in this paper. In fact the application conditions demand not a single channel system but a multichannel one. A silicon-based macroporous IR-emitter, a miniaturised absorption cell and a detector module for the simultaneous measurement with four channels including, ethylene, two interfering gases and the reference signal were integrated in the optical system. The new inner architecture of the detector module, consisted of optical filters which were directly attached by flip-chip technology onto the thermopile-arrays, allowing silicon-based Fresnel multilenses to be attached to the cap of the detector housing. Because of the high reflection losses at the silicon-air surface the Fresnel lenses were coated with zinc sulphide antireflection layers. For the signal processing electronics a preamplification stage and a DSP-based lock-in-amplifier has been developed. Although some of this work is still on-going, first ethylene measurements with the miniaturised gas cell, silicon-based IR-emitter, a commercial thermopile detector and the self-developed system electronics showed a detection limit better than 20 ppm.

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