

INTEGRATED PYROELECTRIC DETECTOR ARRAYS WITH THE SENSOR MATERIAL
PVDF

B. PLOSS, P. LEHMANN, H. SCHOPF, T. LESSLE, S. BAUER,
U. THIEMANN*

Institut für angewandte Physik, Universität Karlsruhe
Kaiserstr. 12, 7500 Karlsruhe, F.R. Germany

*Institut für Halbleitertechnik, Universität Stuttgart

Abstract Integrated PVDF pyroelectric radiation detectors have been made, using a simple technique to interface the pyroelectric material with the silicon substrate. The silicon substrates incorporate the electronics for a 8x1 array and a 2x2 array. The relevant sensor parameters voltage responsivity, detectivity and the thermal crosstalk are measured within a frequency range from 0.01 Hz to 5000 Hz. With the 400 μm thick silicon substrate the voltage responsivity is typically 100 V/W, the maximum detectivity is $7 \times 10^6 \text{ cm}\sqrt{\text{Hz}}/\text{W}$ at a frequency of 30 Hz. An improvement of both voltage responsivity and detectivity is possible by reducing the heat loss to the silicon substrate. This can be realized by a reduction of the substrate thickness, at least underneath the detector area. A further improvement is possible by a reduction of the capacity of the electronic circuit on the silicon chip and by the use of ferroelectric materials with higher pyroelectric coefficients, for example TGS.

INTRODUCTION

Pyroelectric sensor arrays have found many applications during the last years¹. For example, linear arrays can be used for applications in infrared spectroscopy, two dimensional arrays for taking thermal pictures, e.g. for the adjustment of CO₂ lasers. Arrays with a big number of pixels are preferably realized as hybrid or integrated sensors on a silicon chip. Watton et al.² connected the pyroelectric material to the chip via solder bumps, a good but rather difficult and expensive technique. PbTiO₃ was sputtered or CVD grown on chips by Okuyama et al.³. NaNO₂ was grown from the melt on the chips by Engelhardt et al.⁴. Recently, a technique was developed to interface any pyroelectric material on a silicon chip⁵. This is performed by using a dielectric interface which fits the pyroelectric material