An Avalanche Diode Array with Bulk Integrated Quench Resistors for Single Photon Detection

R. H. Richter[1)], L. Andricek[1)], G. Lutz[2)], H.-G. Moser[1)], J. Ninkovic[1)]

[1)]MPI für Physik, München,[2)] PN Sensor GmbH

Nowadays so called Silicon Photomultipliers (SiPM) are going to enter many applications fields currently still occupied by photomultiplier tubes (PMT). Due to their inherent advantages the coverage of many square meters detection area with SiPMs is proposed for many physical experiments. A simple technology allowing a high yield is necessary to keep the detector costs in a reasonable range.

However, the need of high ohmic polysilicon for the quench resistors is one of the most cost driving technological issues. Since the sheet resistance in the required range depends not only on the doping level but also on the shape and size of the polysilicon crystalites the resistor adjustment is not very reliable. Moreover, in particular blue and UV light is absorped by the covering polysilicon resistors which leads to a significant reduction of the photo detection efficiency (PDE).

A frontside illuminated detector structure is proposed having the quench resistor integrated into the silicon bulk. Since also other obstacles for light like metal lines or contacts can be omited by this approach the fillfactor is only limited by the required gaps necessary for optical cross talk suppression. Within the array the entire surface area remains non structured and can be easily covered with an anti-reflective coating layer. Compared to existing devices the proposed structure has the potential of a higher PDE especially in the blue and UV range, an improved hardness against ionizing radiation and a much simpler processing resulting in a higher production yield and lower costs.

Based on device simulations the advantages and drawbacks of those diode arrays will be explained and steps towards first prototypes are discussed.