TNO Science and Industry

TNO | Knowledge for business

J.Leijtens
TNO Science and industry
M.ter Brake
University of Twente
H.Derking
University of Twente
A.Theuwissen
Delft University of Technology
N.Xie Delft
Delft University of Technology

UNIVERSITY OF TWENTE.
TUDelft
MicroNed

Can microcooling open-up new applications for the digital sunsensor chip APS+

The APS+ chip developed within the MicroNed program is designed for sun sensing applications and consequently relies on large input signals. Its noise level can be reduced through cooling, which can open up other applications.

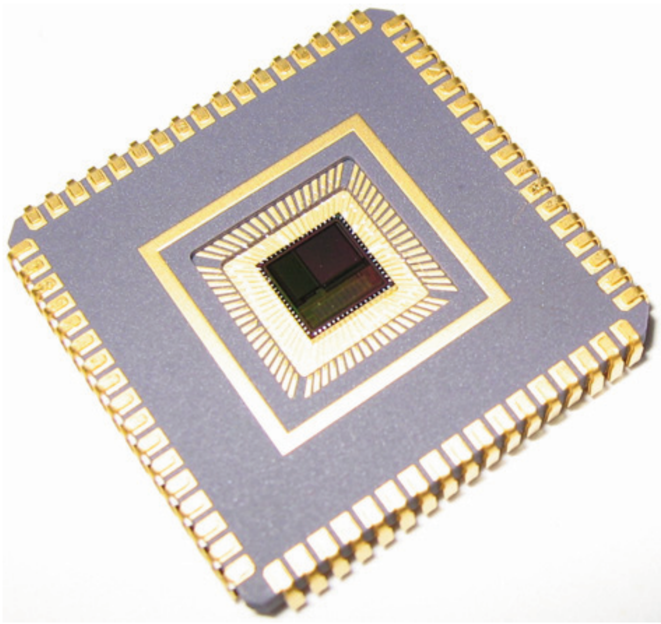

Figure 1: Packaged prototype APS+

The APS+ chip (Fig. 1) is basically a digital centroïder in the sense that the centroïd of the light spot impinging on the chip is determined and digitally communicated to a connected computer. This functionality can be used to design other applications, such as optical monitoring of valves or the control of formation flying satellites. In the latter case, each satellite is equipped with a receiver based on the APS+ and a source. In this way, the direction from which the light is coming towards the satellite can be determined and the relative pointing adjusted accordingly.

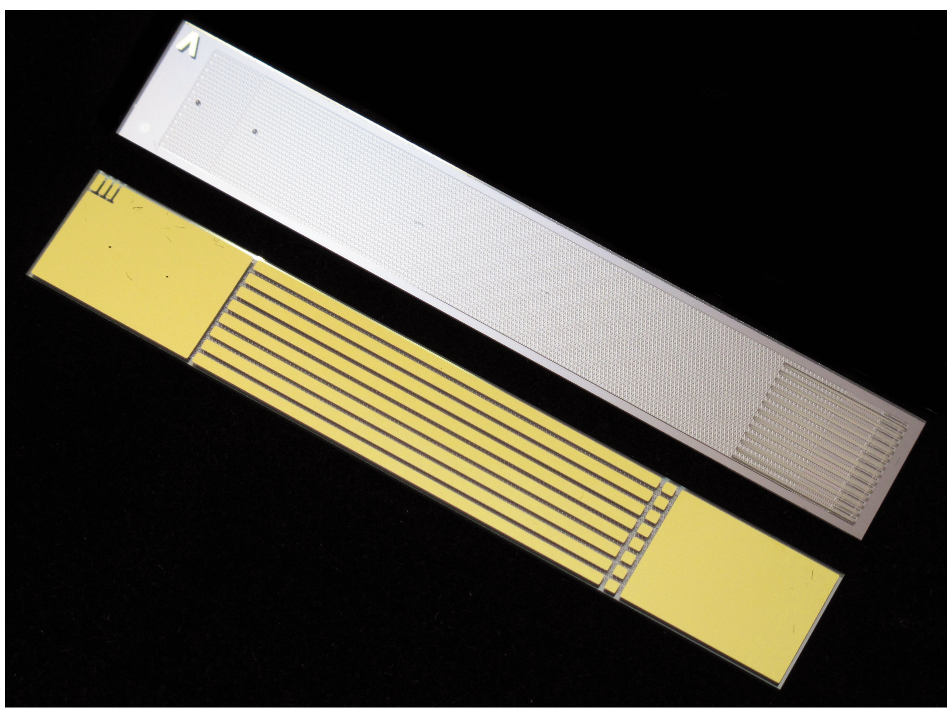

Figure 2: Joule-Thomson microcoolers

The main drawback of the APS+ for this application is the fact that it is designed to look at the sun and consequently has a fairly high noise level, which was traded against radiation tolerance. This noise level can be reduced by cooling the chip down by using a Joule-Thomson (JT) microcooler (Fig. 2). Within the Cooling and Instrumentation group at the University of Twente, these microcoolers are under development within an STW project. Under contract of the European Space Agency, this group investigates the integration of an optical detector with a JT microcooler for future space missions.

As an alternative to cooling a detector with larger pixels and larger optics can be used, but it is expected that the addition of a JT microcooler will result in a considerably smaller system. In order to see which benefits are achieved at system level, a number of experiments have been and will be carried out:

1) The dark current as a function of the temperature of a prototype APS+ chip is measured (Fig. 3) by cooling it with a standard Stirling cooler (Fig. 4).
2) The optimum operating temperature of the sensor will be determined from the dark current data.
3) The properties of A JT microcooler optimized for this APS+ sensor will be determined (Fig. 2).
4) The advantage of using a JT microcooler over a larger optical system will be determined.

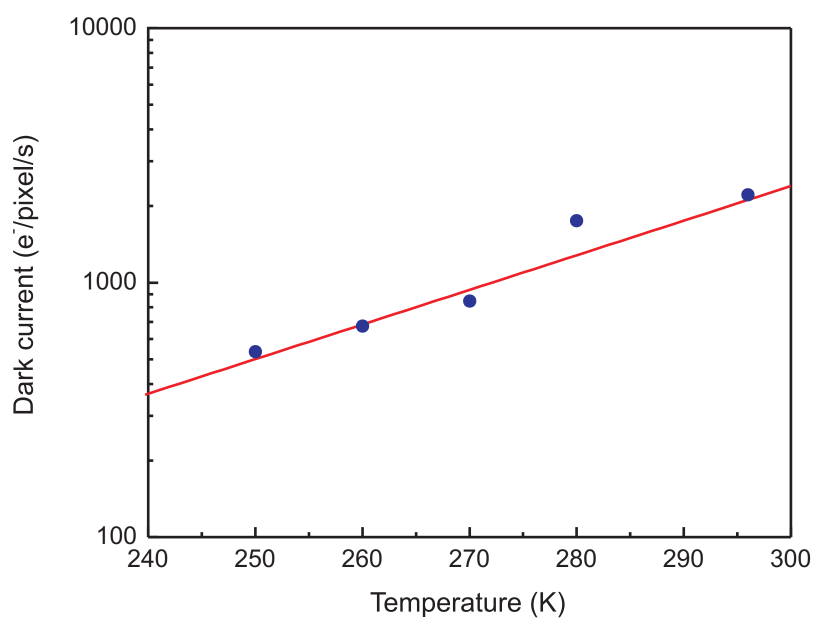

Figure 3: Dark current as a function of the temperature for a prototype APS+ chip

When these experiments show that using a JT microcooler for reducing the noise of this APS+ chip is useful, an integrated microcooler - APS+ system should be built and its performance verified to prove the capabilities.

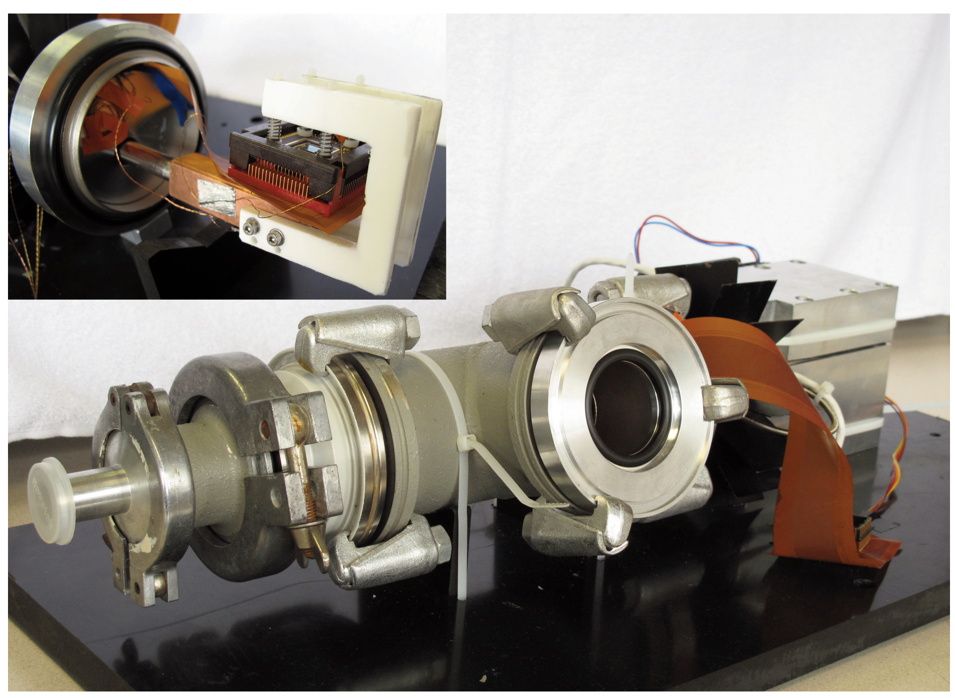

Figure 4: Conventional detector cooling test set-up