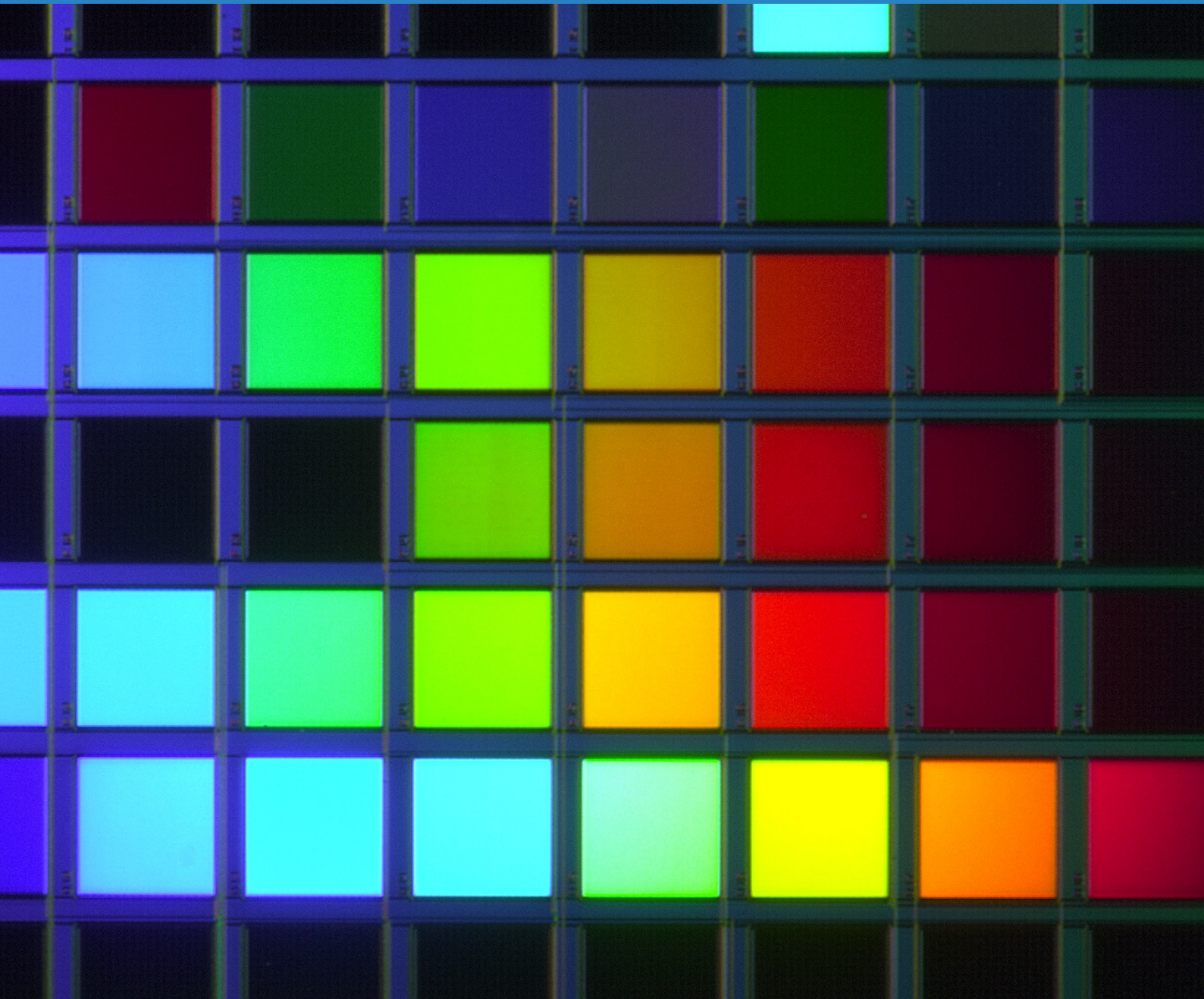


# NANOSTRUCTURED COLOUR AND POLARISATION SENSORS IN CMOS-TECHNOLOGY



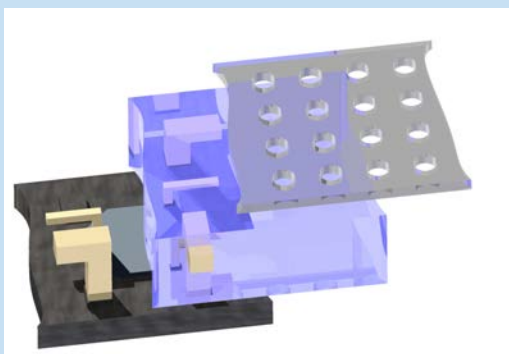


## OVERVIEW

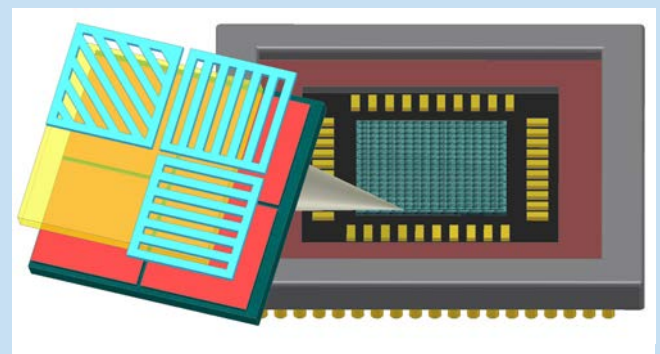
Our institute has comprehensive experience in design of embedded photosensors. To find an economic solution for every assignment, we focus on the use of cost-effective standard CMOS-technology. By structuring the metal planes of a CMOS process, colour and polarisation sensors can be designed with almost arbitrary filter functions.

## TECHNOLOGY

In modern CMOS processes with gate-lengths of 180 nm or below, the metal planes normally used for interconnections can be etched with feature sizes smaller than the wavelength of visible light. These so-called "Subwavelength-Structures" show a unique transmission behaviour for optical waves. By proper design of the structures with gratings or holes in one or more metal layers, optical functionality can be achieved.



*Sensor architecture with nano-structured metal planes, isolating dielectrics and photodiode*



*Scheme of polarisation-imager with polarisation-sensitive sub-pixels*





## MEASURED SPECTRAL SENSITIVITY AND TRANSMISSION OF COLOUR AND POLARISATION SENSORS

### APPLICATIONS

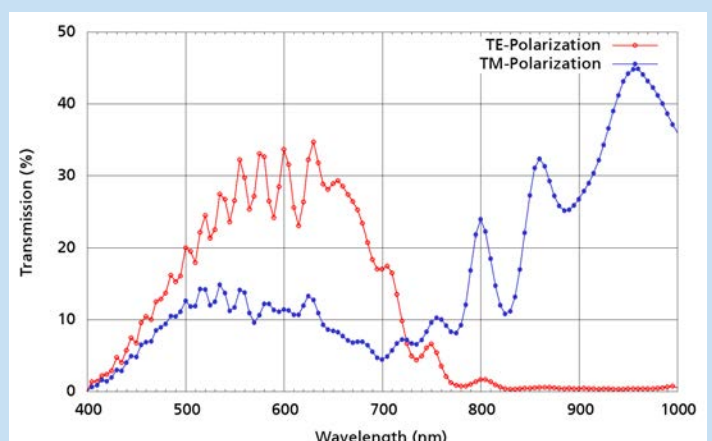
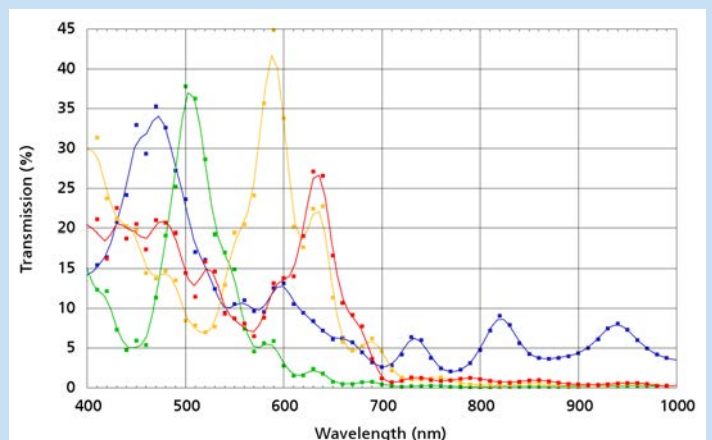
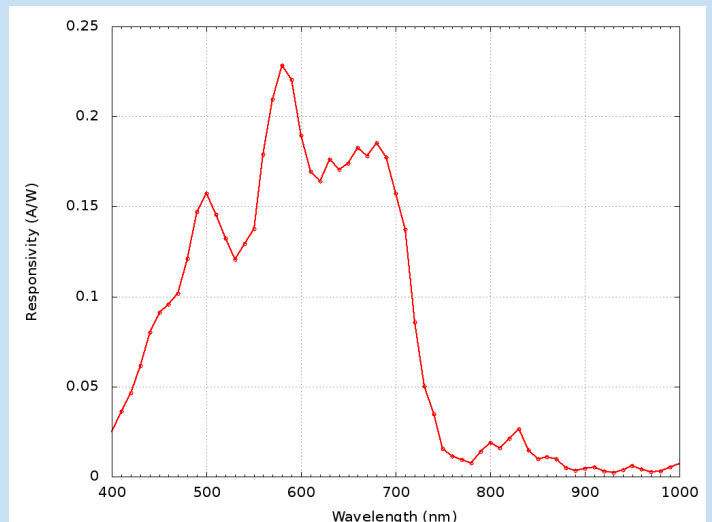
#### Possible applications of spectral sensors are including:

- Control of LEDs in many lighting situations, e.g. in LCD-Backlights
- Application specific colour sensors for industrial automation with almost arbitrary spectral function
- Colour sensors under high temperature or humidity conditions, e.g. in cars
- Miniaturized multi-spectral sensors for analytics of gases and fluids
- Miniaturized perceptive sensors without the need of additional filter layers

#### New Polarisation sensors could be applied in:

- High resolution polarimeters without moving parts for chemical analytics
- Polarisation cameras in quality monitoring, e.g. for monitoring of fabrication process
- Polarisation cameras with increased contrast ratio for inspection of metallic surfaces
- Polarisation cameras for medical diagnostics, e.g. for cell-monitoring
- Ellipsometers for measuring layer thicknesses
- Road surveillance cameras with switchable polarisation for suppression of reflections

Moreover, pixelwise polarization sensing is possible within a standard CMOS technology. A polarization camera is available using state-of-the-art imagers.



Examples for filter transmission performances

a) IR blocking filter, b) Various bandpass filters,

c) Polarisation sensitive filter

**WWW.IIS.FRAUNHOFER.DE**

*Fraunhofer Institute for  
Integrated Circuits IIS*

**Director**

*Prof. Dr.-Ing. Albert Heuberger*

*Am Wolfsmantel 33  
91058 Erlangen, Germany*

**Contact**

*Dr.-Ing. Norbert Weber  
Phone +49 9131 776-9210  
Fax +49 9131 776-4499  
norbert.weber@iis.fraunhofer.de*

