imec
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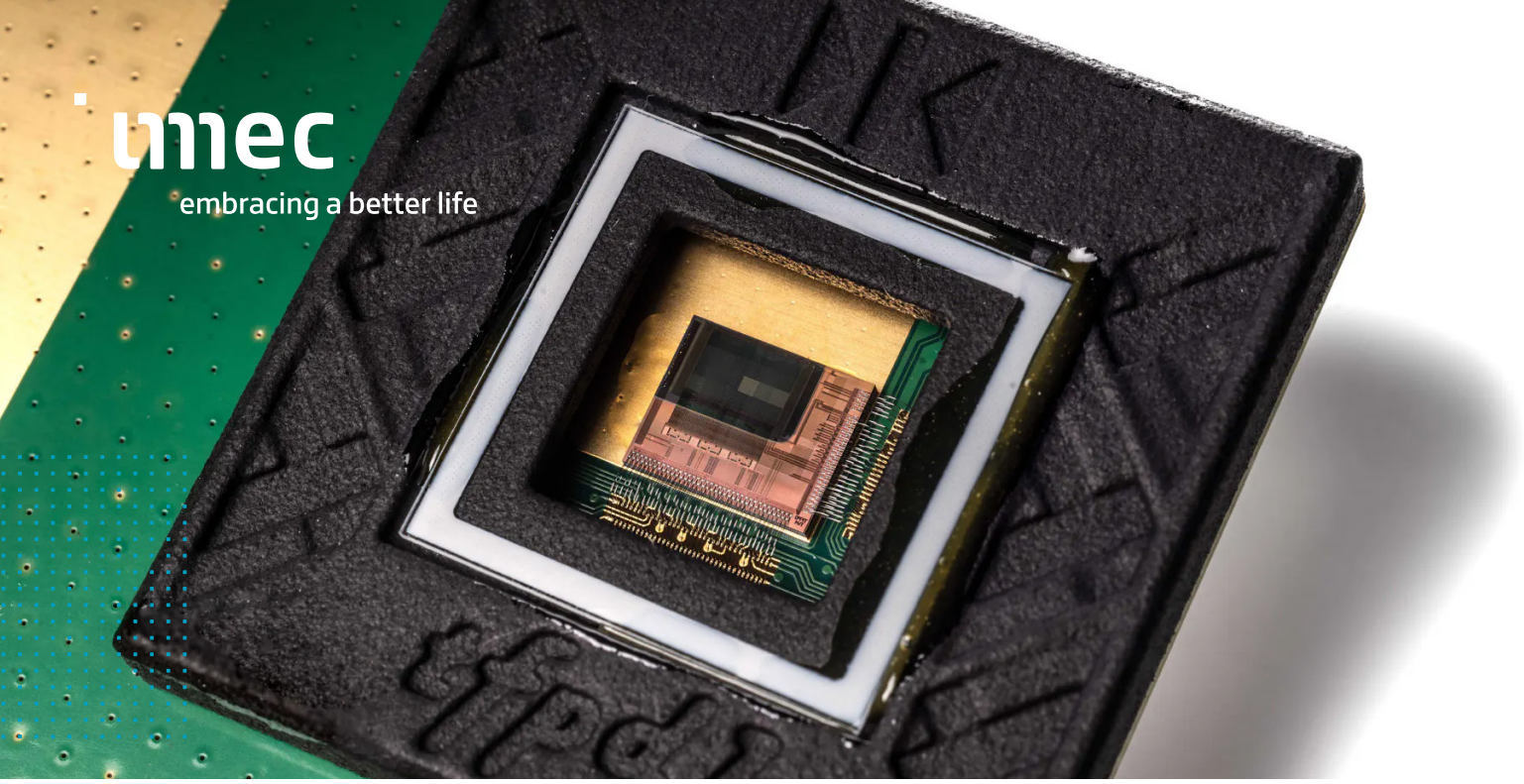


Thin-film infrared imagers

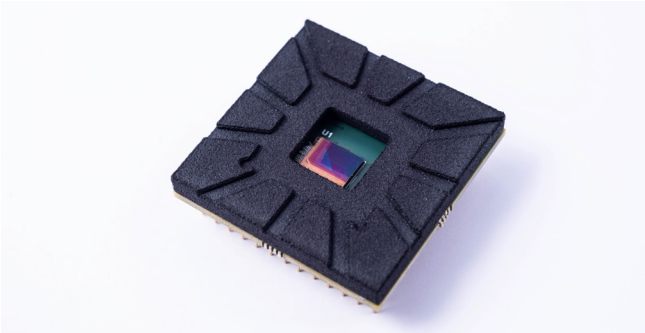
From photography to sensing

Cameras for photography and video are a commodity, with billions shipped every year. At the same time, there is a growing need for image sensors extracting very specific information, such as in biometrics (face identification), automotive (safety in adverse weather conditions), machine vision (sorting) and others, often relying on information that is not visible to the human eye (e.g. in the infrared range).

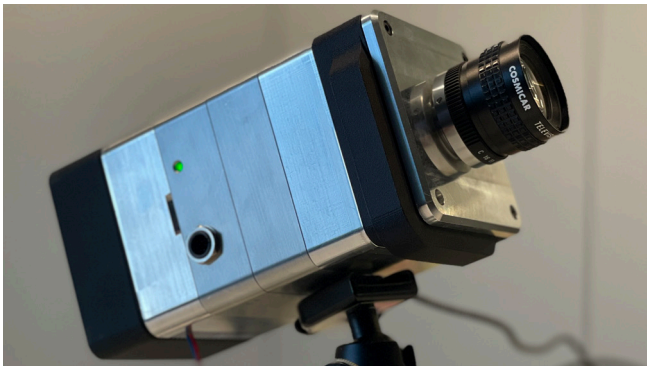
Short Wave InfraRed (SWIR) tradition imaging technology relies on III-V materials hybridized to a silicon readout chip. This results in a very high cost (>10K$ per camera), low resolutions (1 MPx) and high pixel pitch (>5 um). Using alternative solutions, monolithic infrared silicon imagers can be realized to overcome this limitations by leveraging on silicon scaling and low cost wafer-level mass production

Thin-film photodiode pixel stacks

Imec is developing short-wave infrared (SWIR) image sensors based on thin-film photodiode (TFPD) pixel stacks. By using organic and quantum dot materials, imec envisions pixel arrays that are sensitive to wavelengths from the visible to infrared (up to 2 µm) spectrum. Imec's activity spans from material screening and stack development, to pixel and readout design, full fabrication flow including wafer-level processing in the CMOS fab, and camera assembly and characterization.



Monolithic thin-film image sensor for the SWIR range, processed at die level. Imec works towards scaling the process to wafer-level which increases throughput and cost compared to today's conventional IR imagers, while at the same time enabling multi-megapixel resolution.



Imec's thin-film SWIR image sensors can be integrated in camera modules with standard or SWIR lenses.

Key features

Imec's TFPD image sensors enable a compact form factor with a pixel pitch of single micrometers. Different pixel stacks for the infrared range were demonstrated, with focus on the 940, 1450 and 1550nm wavelengths . Our custom-made readout IC has a dedicated pixel engine for new types of thin-film photodiodes and a fab-compatible interface designed for thin-film integration. The pixel stack is optimized for each wavelength and can be patterned with photolithography on pixel-level.

Key Benefits

The thin-film photodiode stacks can be integrated on wafer-level using standard semiconductor fab equipment. This allows to significantly lower the cost and increase the throughput for infrared imagers. This enables low-cost SWIR cameras that can be deployed in a broad range of applications.

Demo description

The demo features a camera based on quantum dots and optimized for the 1450nm wavelength. The array has 768x512 pixels with 5 µm pitch. The sensor is enclosed in a custom package and built into a camera. The camera CAN be pointed at a stage with objects (e.g. looking through a silicon wafer into a rotating stage) or at passers-by. We can see features and contrast which are normally not visible by the human eye. We have also demonstrated a new pixel based on a pinned photodiode concept, enabling cancellation of kTC noise, better linearity and higher full-well capacity.

Offering

Imec aims to develop a wafer-level NIR and SWIR image sensor technology and develop technologies for companies with a roadmap in innovative image sensors, cameras and smart imaging applications. Imec welcomes collaborations with industrial players from the entire value chain of image sensors and systems.

ADAS (see-through fog)

QD imager (SWIR)

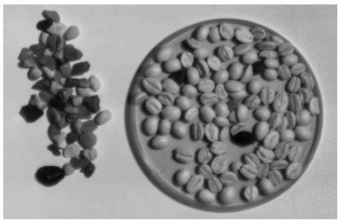
CIS webcam (VIS)

Driver monitoring (see through sunglasses)

QD imager (SWIR)

CIS webcam (VIS)

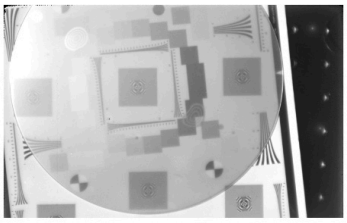
Food sorting (stones among coffee beans)



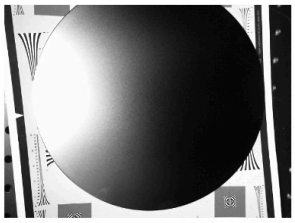
QD imager (SWIR)

CIS webcam (VIS)

Wafer inspection (detection of voids after bonding)



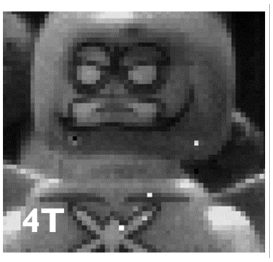
QD imager (SWIR)



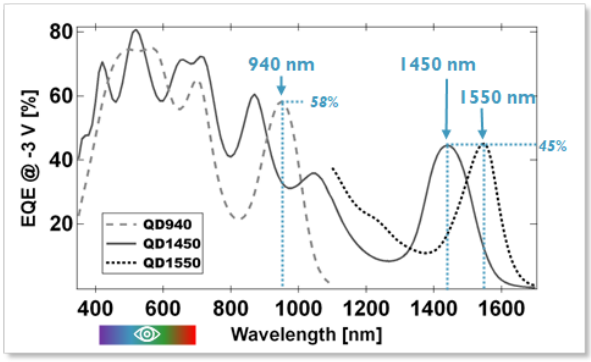
CIS webcam (VIS)

Low-noise pixel (thin-film pinned photodiode (TF-PPD))

Standard 3T pixel



"TF-PPD" pixel



EQE of single pixel test photodiodes on Si

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