Recent progress of Back-illuminated CMOS image sensors (BI-CISs), focusing on their pixel improvements with the design of optical properties using subwavelength size scale structures and photonics technologies, are reviewed. These technologies contribute not only improving BI-CIS basic performance but also adding new functions for versatile sensing applications.

A 0.8 μm-pitch 64 megapixels CIS has been demonstrated for the first time. 6k e- full-well capacity (FWC) was achieved, and the advanced color filter isolation was introduced. Dual conversion gain enhanced the Tetracell FWC to 12k e-. Highly refined deep trench isolation and photodiode also improved dark noise characteristics.

We created the world's first all PDAF CMOS image sensor using 2x2 on-chip lens architecture. That had 1/2 inch 48M pixels with 0.8μm Quad Bayer coding for high resolution and HDR function, and all PDAF pixels achieved a minimum AF illuminance level of 1 lux.

This paper introduces a 2.2μm stacked BSI voltage domain global shutter CMOS image sensor displaying over 100dB shutter efficiency, as well as high NIR-QE of 38% at 940nm, 60% MTF Ny/2 at 940nm with stacked pixel level connections, high density MIM capacitors, and Full back-side Deep Trench Isolations.

Plasma process interaction with BSI image sensor is for the first time presented. The backside dielectrics properties modulate the damage, this was characterized by measuring the dielectrics charge and the
interface state density. Metal oxides present a better hardiness to plasma damage due to their negative charge even after plasma.

**11:35 AM  16.6**  Three-layer Stacked Color Image Sensor With 2.0-μm Pixel Size Using Organic Photoconductive Film


A three-layer stacked color image sensor was formed using an organic film. The sensor decreases the false-color problem as it does not require demosaicing. Furthermore, with the 2.0-μm pixel image sensor, improved spectral characteristics owing to green adsorption by the organic film above the red/blue photodiode, were successfully demonstrated.

**12:00 PM  16.7**  High-definition Visible-SWIR InGaAs Image Sensor using Cu-Cu Bonding of III-V to Silicon Wafer


We developed a back-illuminated InGaAs image sensor with 1280 x 1040 pixels at 5-μm pitch by using Cu-Cu hybridization connecting different materials, a III-V InGaAs/InP of photodiode array, and a silicon readout integrated circuit (ROIC). A prototype device showed high sensitivity at visible to SWIR wavelengths and low dark current.