IDEC Chip Design Contest

A Low Power Monolithic CMOS Digital Sun Sensor with Integrated Window Layer

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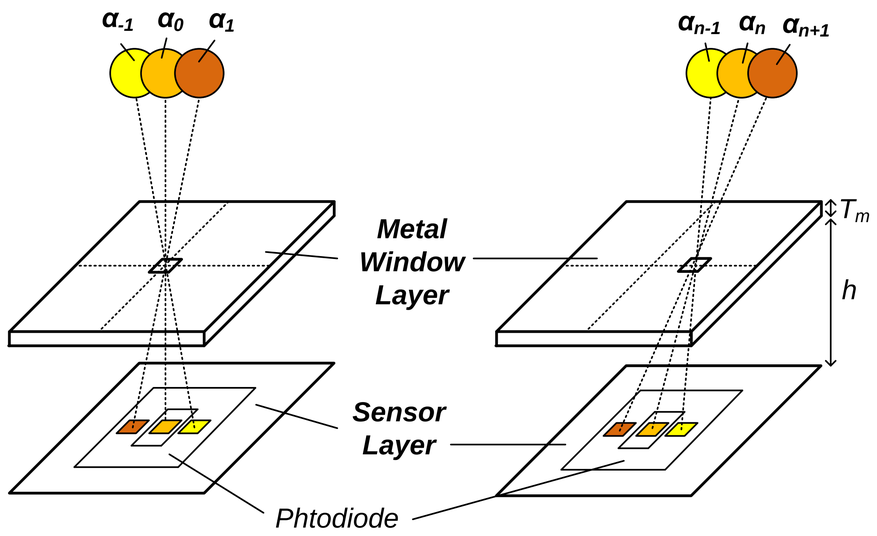
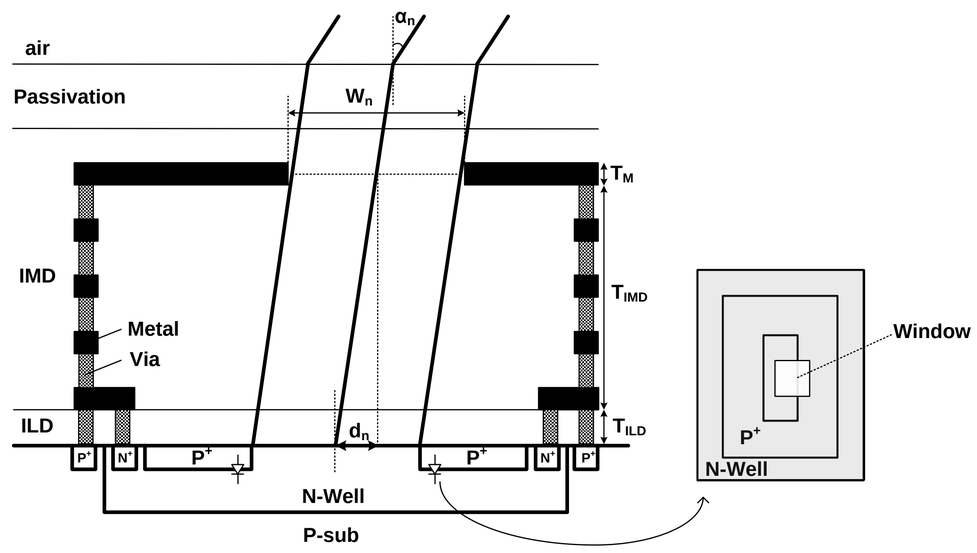
I. Abstract

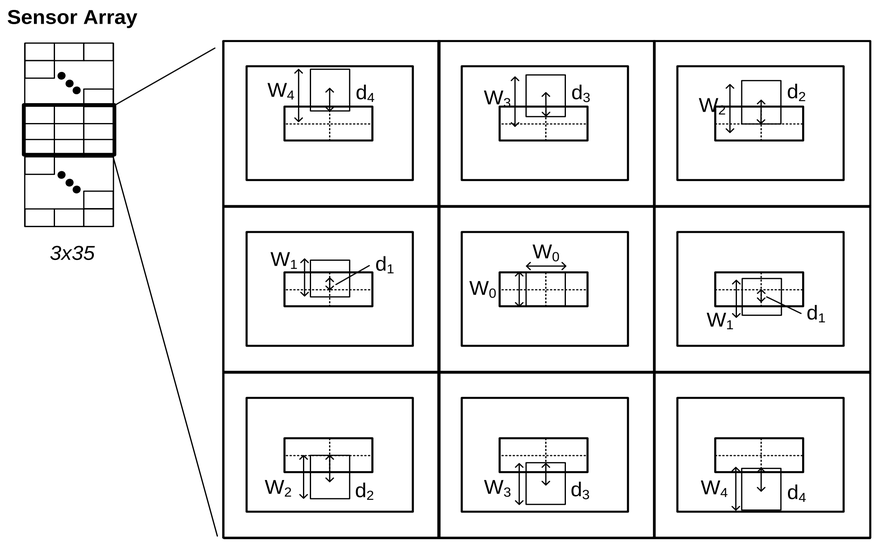
- The sun sensor is used for nano-satellites, spacecraft, solar power plants, heliostats and so on
- Proposed work aimed for low power, small size, and mass production by integrating window layer
- Proposed structure could reduce the mismatch of two different photodiodes in conventional work
- Implemented in 0.18μm CMOS process, occupies 1.13x0.76mm^2 core size and consumes 8.6μW

II. Proposed Work



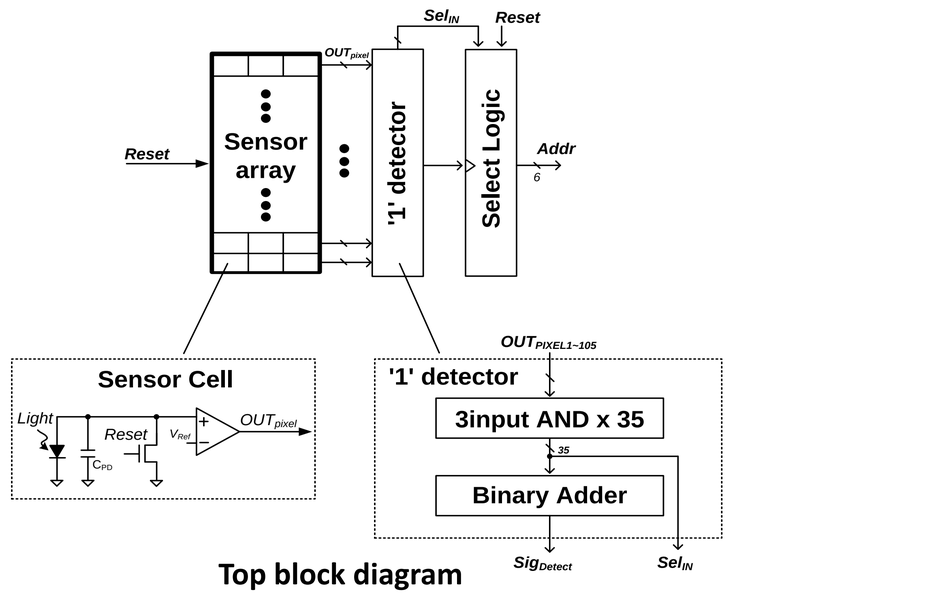


Proposed Concept



Window Layer

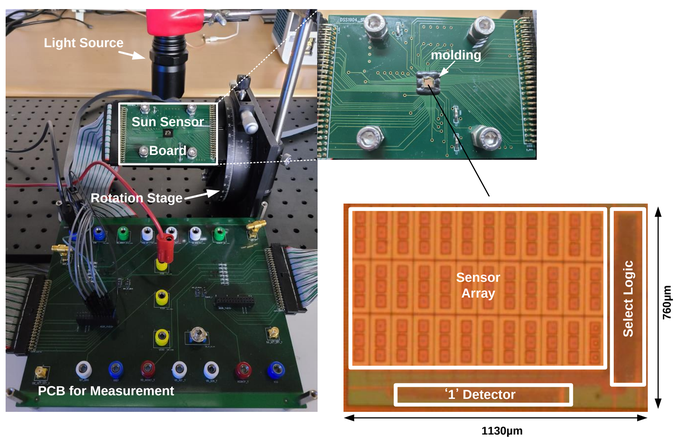
Proposed single sensor cell structure with single photodiode



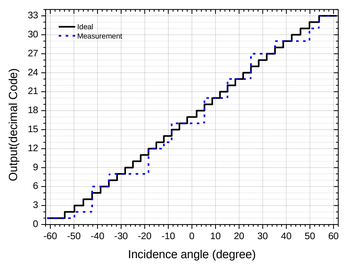
Top block diagram

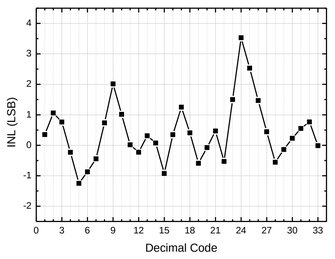
- Separated implementation of window layer in conventional work has disadvantage at mass production
- Conventional monolithic light angle detector is vulnerable to mismatch
- Proposed work could reduce the effect of mismatch by integration of single photodiode with a single sensor cell
- Integrated shifted multiple aperture window layer is implemented with metal layer
- Incidence of light path was modeled with BEOL(Back end of Line) consideration

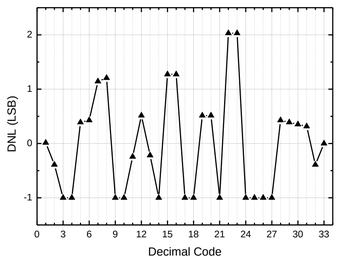
III. Implementation and Measurement



Measurement setup and photomicrography







	This Work
Type	Monolithic Single photodiode
process	180nm CMOS
Power supply	1V
Pixel Array	2×(3×35)
Pixel size	38.94μm × 48.94μm
Silicon die size	(3.4 × 3.4) mm^2
FOV (Field of View)	122.6°
Resolution	3.3°~7.4°
accuracy	11.65°
Power consumption	8.66μW

Results

V. Conclusion

- Integrated window layer and sensor array was implemented in 0.18um CMOS process
- Proposed sun sensor consumes 8.6μW with 3.3° ~7.4° resolution, 11.65° accuracy and 122.6° FOV