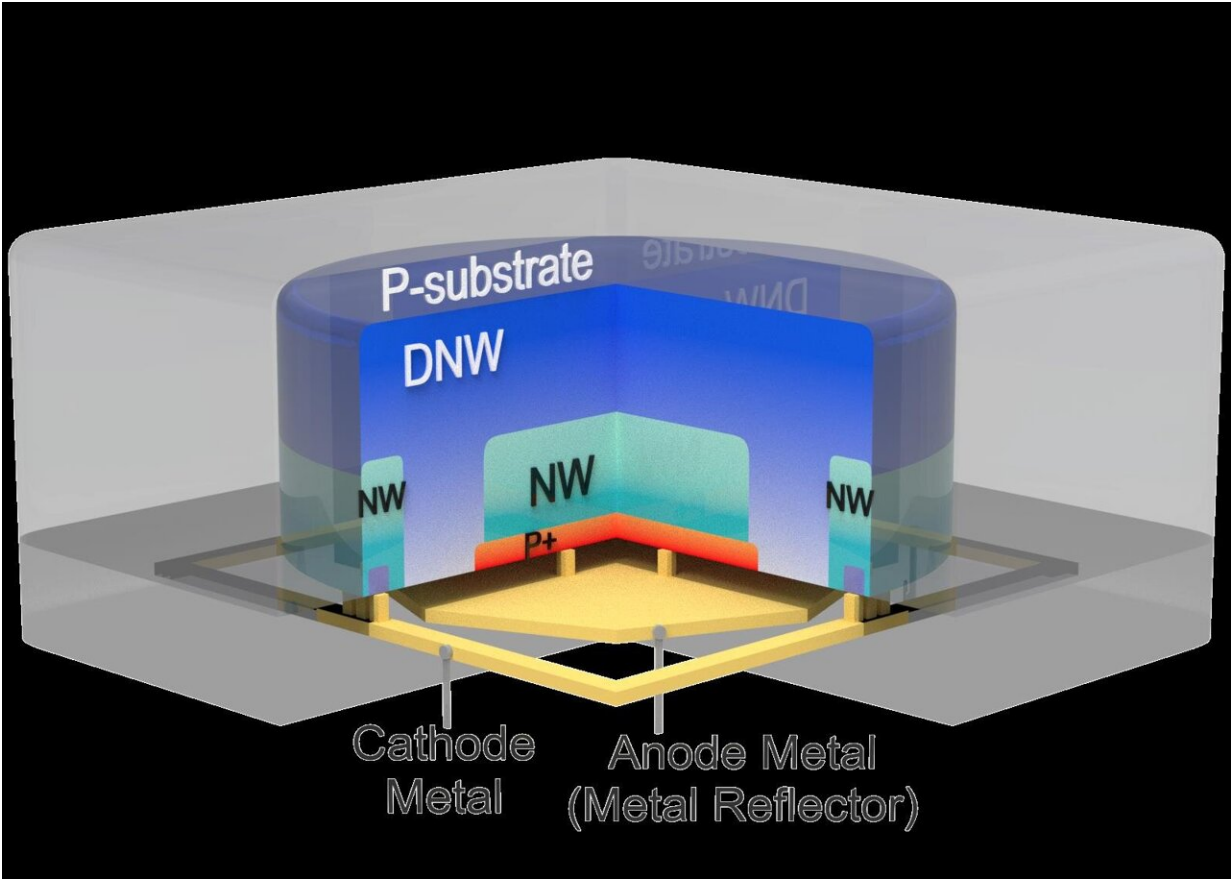


Key LiDAR sensor elements for autonomous vehicles made with Korean technology

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KIST single-photon avalanche diode developed in SK hynix's 40 nm back-illuminated CMOS image sensor technology. Credit: Korea Institute of Science and Technology (KIST)

LiDAR sensors are indispensable for the realization of advanced technologies such as advanced driver assistance systems (ADAS), autonomous driving, and AR/VR. In particular, short- and mid-range LiDAR used in AR/VR devices and smartphones requires better distance (depth) resolution to detect the shape of a person or object more accurately, and so a single-photon detector with better timing jitter performance is required.

LiDAR measures distance and creates a 3D image by calculating the time it takes for a photon emitted by the transmitter to strike an object, reflect, and arrive back at the receiver. The slight difference in detection time that occurs when the single-photon detector at the receiver converts the light signal into an [electrical signal](#) is called "timing jitter," and the smaller the value of this jitter, the more accurately the object can be recognized.

The Korea Institute of Science and Technology (KIST) announced that a team led by Dr. Myung-Jae Lee at the Post-Silicon Semiconductor Institute has developed a "single-photon avalanche diode (SPAD)" that can identify objects at the mm level based on a 40nm back-illuminated CMOS image sensor process.

SPADs, which are ultra-high-performance sensor devices that can detect single photons, are extremely difficult to develop, and to date, only Sony of Japan has successfully commercialized SPAD-based LiDAR based on its 90nm back-illuminated CMOS image sensor process and supplied it to Apple products.



Semiconductor chip with ultra-high-performance sensor elements developed by Dr. Myung-Jae Lee's research team at KIST's Advanced Semiconductor Devices and Systems Laboratory (ADS Lab). Credit: Korea Institute of Science and Technology (KIST)

Sony's SPAD shows better efficiency than back-illuminated SPADs reported in the literature, but its timing-jitter performance of about 137~222ps is insufficient to realize user discrimination, gesture recognition, and accurate shape recognition of objects required in short- and mid-range LiDAR applications.

The single-photon sensor element developed by KIST has significantly improved the timing-jitter performance by more than two times to 56ps, and the distance resolution has also been improved to about 8mm, which

has great potential for utilization as a short and mid-range LiDAR sensor element. In particular, since the SPAD was developed based on the 40nm back-illuminated CMOS image sensor process, a semiconductor process for [mass production](#), through joint research with SK hynix, it is expected to be immediately localized and commercialized.

"If commercialized as a core source technology for semiconductor LiDAR and 3D image sensors, it will greatly enhance our competitiveness in next-generation system semiconductors, which are Korea's strategic industries," said Myung-Jae Lee, principal investigator at KIST.

Provided by National Research Council of Science and Technology

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