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Development and Evaluation of a Large-Area Silicon Strip Detector for Inverse Kinematics Beam Experiments at RAON

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Abstract

We report the development and application of silicon strip detectors for the ELARK (Elastic Scattering Detector ARray in inverse Kinematics) experiment, conducted at Korea's RAON (Rare isotope Accelerator complex for ON-line experiments). These detectors are the first silicon sensors independently fabricated in Korea for use in a RAON beam experiment and were successfully integrated into the ELARK system.

The sensors were fabricated on 6-inch high-resistivity n-type silicon wafers with a thickness of 500 μm . Each sensor features eight strips with a 4.86 mm pitch, yielding an active area of approximately 77 mm $\times$ 42 mm. The design was tailored to match the mechanical specifications of the 1 mm-thick Micron X6 sensor, with both detectors employed as a pair in the ELARK system for ΔE -E proton identification.

Electrical characterization through I-V measurements confirmed low leakage current, indicating reliable performance under experimental conditions. Laboratory tests using radioactive sources demonstrated excellent charge collection and energy resolution, with FWHM values of 31 keV for Am-241 and 26 keV for Gd-148.

The sensors were also integrated into the full ELARK system and used for system-level energy calibration with alpha sources prior to beam irradiation. Clear separation of the Gd-148 and Am-241 peaks was observed, confirming that sensor performance was well maintained after system integration.

Finally, the sensors were employed in a $^{40}\text{Ar}+p$ elastic scattering experiment, functioning as the ΔE detector in a ΔE -E particle identification setup. They exhibited stable signal response, good signal-to-noise ratio, and time stability throughout the beam operation.

This work demonstrates the successful in-house fabrication and application of large-area silicon strip detectors in one of the first beam experiments at RAON. The detectors played a key role in energy selection within the ELARK system. This presentation will cover the design concept, fabrication process, electrical and laboratory characterization, and system/beam performance evaluation of the detectors.