HYGER

Highly efficient IR detection unit based on high-purity black germanium technology

PUBLIC SUMMARY

Our new device concept will enable reasonably priced sensors that can see in the dark, detect much smaller cancer tumours and revolutionize the detection limits of scientific equipment, which have so far been only a subject of imagination. We believe that such breakthroughs in sensor technology can be achieved using three unconventional approaches in photodiode manufacturing that we developed in the previous pilot action (ATTRACT Phase 1).

First, we developed a concept where the charge collection is realised via a dopant-free inversion layer, which enables collection of the signal with very little electrical losses.

Second, we replaced commonly used PECVD dielectric layers by atomic layer deposited highly charged thin films, which allow accurate control of the presence of charge-carriers at the surfaces. Such field effect passivation reduces surface recombination and provides excellent interface quality with record-low surface recombination velocity (SRV).

Third, instead of the traditional approach to use a thick AR coating on a flat surface, we eliminated the reflectance from the detector surface by the application of a specific nanotexturing process to Ge surfaces. Such nanostructures eliminate the need for a separate AR coating and result in fully absorbing surface at wide range of wavelengths and acceptance angles as well as provide efficient light trapping paths inside the substrate.

All these developed approaches lead to Ge sensor element that has superior sensitivity in NIR and lowenergy x-ray detection. In Phase 2, we partner with experts from industry from different parts of the detector value chain and together with them aim to scale up our Phase 1 technology to industrial system-level prototypes and even to commercial products. Our selected technology demonstration case is high-purity germanium detector technology module that can be used in a variety of systems such as NIR fluorescence and Raman spectroscopy, with typical wavelengths ranging from 850 nm to 1.7 μm.

We have selected this demonstration case as our device concept is expected to be ground-breaking in 3-dimensional coaxial and thick crystals used in high purity Ge detectors that are currently relying on complex ion implantation and annealing procedures. With the selected partners the industrial process integration of our black Ge sensor element is straightforward allowing a fast route for technology module demonstration in industrial environment, i.e. at the facilities of Baltic Scientific Instruments Ltd, and eventually commercialisation in the selected end-user systems.

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