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Press release

Defence on 05 November 2021

Defence of doctoral thesis in the field of Semiconductor Device

Title of the doctoral thesis	Processing and interconnections of semiconductor sensors for photon and particle radiation detection
Content of the doctoral thesis	In our society today, the demand for semiconductor devices is higher than ever before. Semiconductor detector devices are one example of these. This study focused on high-end semiconductor sensors, which are essential devices for medical, space and high energy physics (HEP) detections including Large Hadron Collider (LHC) experiments facility at CERN. Pixel detectors made of silicon have been installed in the inner most particle tracking detector layer at LHC. Detectors deteriorate under the harsh radiation environment. One of the approaches to enhance the bulk silicon radiation tolerance is using p-type magnetic Czochralski (MCz) silicon. This mitigates an n-type inversion problem. Also, the fixed oxide charge is a surface related problem. The SiO2 insulation layer disturbs the detector charge collections at SiO2-Si interfaces. The atomic layer deposition (ALD) of thin film aluminum oxide (Al2O3) is negatively charged oxide film. The research proved application of ALD Al2O3 insulator to replace the problem of SiO2. The ALD Al2O3 insulator layer enabled an AC-coupling pixel structure, while eliminating p-stop or p-spray inter-pixel isolation. Also, the thin film TiN layer introduced biasing individual pixels as an alternative method to the punch through resistor (PTR) or the poly silicon resistor. For photon counting detectors, CdTe and GaAs are well-known sensor materials. They have superior energy resolution. However, their chip scale processing is challenging. ALD Al2O3 insulator layer was also applied into CdTe pad and pixel detectors. The laser writing processing enabled a design freedom. The chip scale processing of the photon counting detector was established during this study. The research included interconnection technology using flip chip bonding (FCB). The pixel detectors were consists of a sensor chip and an application-specific integrated circuit (ASIC) chip. The hybridized detectors were tested with radioactive sources, confirming their pixel functionalities.
Field of the doctoral thesis	Materials Science
Doctoral candidate and contact information	M.Sc. Akiko Gädda akiko.gadda@okmetic.com
Defence date and time	05 November 2021 at 12 o'clock
Remote defence	https://aalto.zoom.us/j/66095957049
Place of defence	Aalto University School of Chemical Engineering, Lecture hall Ke2 (Komppa-Sali) Espoo
Opponent	Dr. Michael Campbell; CERN (Conseil Européen pour la Recherche Nucléaire)
Custos	Professor Sami Franssila, Aalto University School of Chemical Engineering, Department of Chemistry and Materials Science
Link to electronic thesis	https://aaltodoc.aalto.fi/handle/123456789/51
Keywords	Semiconductor pixel detector, Atomic layer deposition (ALD), Silicon, GaAs, CdTe

Väitöskirja on julkisesti nähtävillä osoitteessa https://aaltodoc.aalto.fi/doc_public/eonly/riiputus/?lang=fi