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DISSERTATION TITLE: *Interaction of Vacancies with Common Impurities in Crystalline Silicon*

Silisium er fortsatt et dominerende materiale for mikroelektronikk og solcelleindustrien. Egenskapene til silisium er i stor grad styrt av defekter og urenheter. Defektene og urenhetene har en tendens til å interagere på ulike trinn av komponentfabrikasjon. Hydrogen og oksygen er en av de dominerende urenhetene, mens vakanser er en grunnleggende defekt i monokrystallinske silisium. På denne avhandlingen, har interaksjon mellom vakanser og hydrogen og oksygen blitt undersøkt ved hjelp av elektriske karakteriseringsmetoder. Flere ukjente signaler er blitt observert i silisium. Resultatene ga oss mulighet til å kjennetegne egenskapene og identifisere deres natur.

Defects are imperfections of the crystal lattice in solids. They play a significant role in physics of semiconductors. Electrically active defects give rise to electrical levels (states) in a material and can affect important properties of a semiconductor, such as charge carrier concentration and their lifetime. These parameters are critical for semiconductor devices including solar cells.

Nowadays, the solar cell industry is mainly based on silicon technology, and defects evolution at different stages of solar cell production is of considerable scientific interest. The dominant impurities in silicon are oxygen and hydrogen; they are involved in most defect reactions in crystalline silicon. In particular, hydrogen incorporation is a promising technology, since highly mobile hydrogen atoms suppress the electrical activity of harmful defects. Vacancies are fundamental defects in silicon. Their formation takes place during different steps of device fabrication, and they are also involved in defect reactions. Thus, the interaction of vacancies with oxygen and hydrogen is of vital importance.

In this thesis, oxygen- and hydrogen-related states were studied. Particularly, after hydrogenation of silicon we have observed a formation of several deep states of unknown nature, which are potentially harmful for silicon device performance. One of these levels has not been previously reported. The application of electrical characterization methods allowed us to describe the properties of these states and identify them as signals of divacancy-hydrogen and trivacancy-hydrogen complexes.