List of topics for final theses in IQMA

- All topics listed below can be edited in German or English language.
- If you are interested in one of the topics, **please send us a short CV, your transcript of records and your preferred topic. A grade point average in previous bachelor/master courses better than 2.5 is required. Applications for part-time studies are not possible, only full time studies are practicable.**
- Appointments for presentation of specific topics after consultation via e-mail: Every week on Wednesday 1:15 pm. Meeting Point: office E114
- Own topics in the field of thermal, electrical or thin film characterization are also welcome.

Description	Suitable for Master of applied Research
Research and, if applicable, building and implementation of alternative methods for electrical characterization of ultrathin films, e.g.: • Conductive atomic force microscopy (C-AFM) • Wafer-Level-Testing • Breakthrough behaviour • Reliability testing • others	NO
Research and, if applicable, building and implementation of alternative methods for thermal characterization of ultrathin films, e.g.: • Raman spectroscopy • Macroscopic and microscopic 3-Omega method • Laser flash, time-domain thermoreflectance technique (TDTR) • Scanning thermal microscopy (SThM) • Optical methods • others	NO
Development of Quantitative Scanning Thermal Microscopy (SThM) using microscopic 3-Omega method • SThM is a method for the qualitative determination of the local thermal conductivity using atomic force microscopy (AFM). A measuring probe with a tip radius of a few 10 nm is scanned over a surface and the local thermal conductivity is determined using special evaluation electronics. • The SThM methods currently used at the IQMA can currently only provide qualitative results that need to be calibrated in an elaborate way. The aim of this work is to supplement the existing measuring equipment with the necessary components (e. g. lock-in amplifiers) in such a way that the qualitative thermal conductivities are converted into quantitative values. • Methods: SThM measuring station in the atomic force microscope (AFM), AFM evaluation software, if applicable. Programming languages • Combination of SThM and macroscopic 3-Omega method • Possibly use of different SThM tips	YES

Investigation and elimination of the topographical influence in scanning thermal microscopy (SThM) using mathematical methods • SThM is a method for the qualitative determination of the local thermal conductivity using atomic force microscopy (AFM). A measuring probe with a tip radius of a few 10 nm is scanned over a surface and the local thermal conductivity is determined using special evaluation electronics. The geometry of the tip and sample falsify the thermal images obtained. The aim of this project is to eliminate these errors using mathematical methods (e.g. convolution) and thus to increase the spatial resolution of the SThM measurement method. • Methods: SThM measuring station in the atomic force microscope (AFM), programming languages, AFM evaluation software	YES
Optimization of atomic force microscopy (AFM) methods for the analysis of the topographic, thermal and electrical properties of thin layers • In the Atomic Force Microscope (AFM), a measuring point (radius of a few 10nm) is moved rasterly over the sample surface. A 3D model of surface topography is created by means of an optoelectronic control circuit and with evaluation by appropriate routines. • The aim of this project is to make qualitative statements about the weighting of the different influencing factors of AFM measurements, e.g.: o The influence of the mode (contact, intermittent, non-contact mode) on the quality of the surface resolution. For this purpose, comparative measurements on laser scanning microscope (LSM) and scanning electron microscope (SEM) are sought. o The influence of different tips (tip radius and spring constant) o The degradation of different peak types in successive scans o The influence of the scan frequency o Testing of advanced modes like e. g. Scalpel AFM for the systematic removal of material, as well as TUNA for the determination of local electrical conductivity • Methods: Different AFM modes, if applicable. Laser Scanning Microscopy (LSM) and Scanning Electron Microscopy (SEM), Software Nanoscope Analysis and Origin, possibly. Programming languages Labview and Matlab	YES
Thermal conductivity measurements of thin films using the 3-omega method • The main focus is on the influence of different thicknesses of 3-omega structures on the measurement result. Optionally, the existing measurement setup can also be automated. • familiarisation with the subject of thermal conductivity and the 3-omega method • (Optional: Automation of the existing measurement setup) • Perform some test measurements to become familiar with the measurement setup • Detailed examination of different measuring structures with emphasis on thickness and composition of the measuring structure • Transferring the knowledge gained to different materials	YES
Construction Measurement technology / Electrical characterization of dielectric materials for future electronic components • Working on parameter analyzers of the latest generation B1500A / Keysight • Measurement program design with EasyExpert or LabView https://www.keysight.com/en/pc-1676166/easyexpert-group-device-characterization-software?cc=DE&lc=ger • Optimization of measurement setup (suess wafer probes/micromanipulators) • familiarisation with issues of reliability • Further development of existing measurement methods • Development and execution of tests using a parameter analyzer at a terminal • Research / Adaptation / Further development of degradation models • Lifetime projection based on measurement results/model parameters • Conducting comparative measurements and supplementary characteristics	YES

Thermal simulations using LTSpice • Using electrical and thermal analogies (voltage-temperature; electrical resistance-thermal resistance, etc.) • Theoretical research about useful and feasible simulation models in our field of research • Practical implementation of elected simulation cases • Comparison of results with theoretical calculations or practical measurements • Possible simulation case: Heat transfer regarding scanning thermal microscopy	YES
Investigation and optimization of scratching dynamics during scalpel AFM operation ○ Standard AFM modes generally allow the analysis of surface or close-surface material properties only ○ Due to the ongoing miniaturization trend in Semiconductor technology, electronic components are more and more realized in a compact three-dimensional manner ○ By using appropriate AFM tips with individually optimized scan parameters it is possible, similar to computer tomography, to remove individual material layers of certain thicknesses. ○ The aim of this project is to evaluate different AFM tips regarding their eligibility for Scalpel AFM applications. Furthermore, the influence of the various scan parameters shall be investigated and tuned to remove individually defined thicknesses of various materials. Of special interest is the influence of the thereof induced pressure on material parameters like e.g. the electrical conductivity	YES