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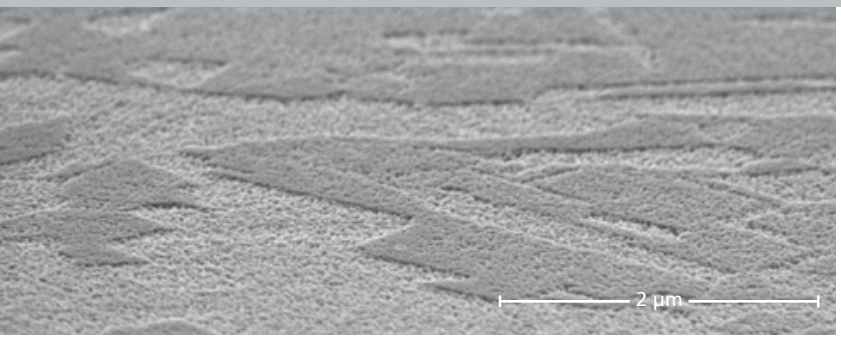
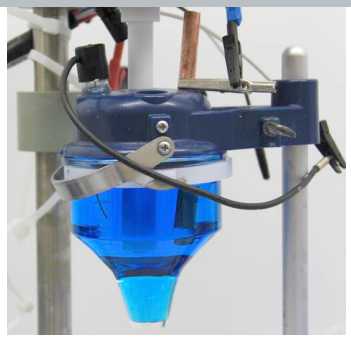
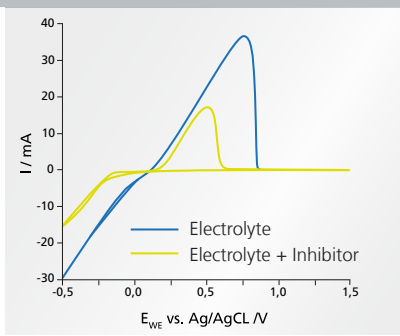
FRAUNHOFER INSTITUTE FOR PHOTONIC MICROSYSTEMS IPMS
CENTER NANOELECTRONIC TECHNOLOGIES (CNT)



Grain orientation dependent corrosion of electroplated copper by CMP slurry (SEM image)



Cyclovoltammetric measurement setup including copper electrolyte



CVS measurement of a copper electrolyte with and without deposition inhibitor

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ELECTROCHEMISTRY IN MICROELECTRONICS

INTERCONNECTS | HIGH-K DEVICES | NON-VOLATILE MEMORIES

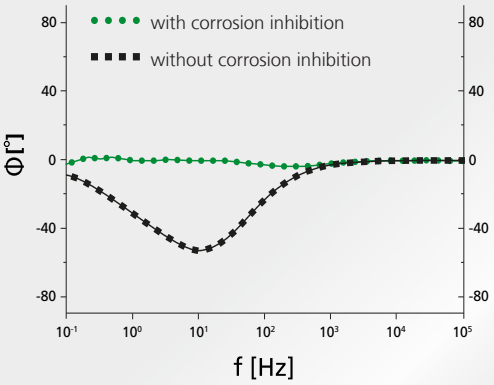
LAB-TO-FAB SERVICES

Electrochemical engineering is a fundamental part of the industrial society with a variety of applications in environmental engineering, energy & surface technology, corrosion inhibition, analytics & sensing and micro- & nanotechnology. Charge transfer processes of electrical charge carriers (electrons, ions) at phase boundaries as well as the transport mechanisms within all kinds of electrolytes and electronic materials are key factors for improving the capability of microelectronic products.

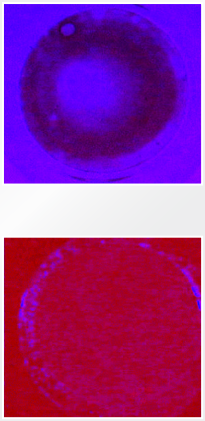
Fraunhofer IPMS-CNT is specialized in the application of electrochemical mechanisms and analytics for material development and processes characterization at nanometer scale in order to address today's and tomorrow's challenges in the fields of automotive, industry 4.0, IoT, energy harvesting and storage and sensor development. As a part of the lab-to-fab screening platform, we offer services ranging from electrochemical screenings and analytics, functionalization of substrates up to electrochemistry based technology integration.

PROCESSES

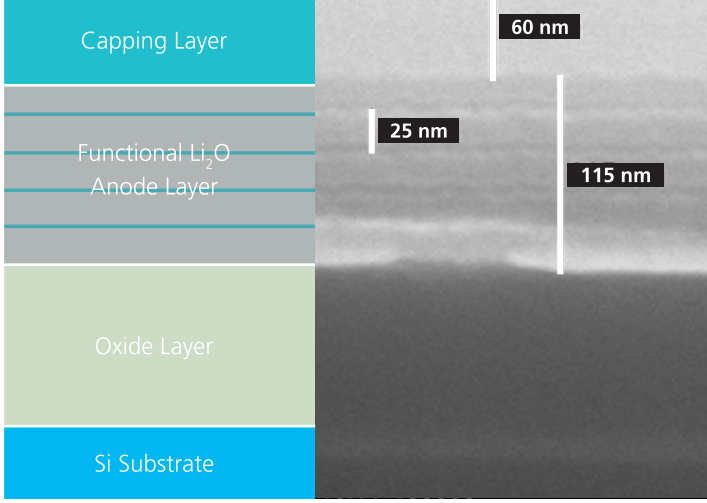
- Metal depositions:
  - Galvanic processes ECD/ELD: Au, Ag, Cu, Co, Sn
  - Oxides or Nitrides of ALD processes: Co, Ni, Al, Zr, Hf, Sr, Ti, Li, Si
  - CVD processes: Co
  - PVD processes: Au, Ta, Ti, Cu, Co, Ni, Li, Cr, Pt
- Wet coating / treatment of substrates with corrosion inhibitors
- Copper ECD: Lab-to-Fab services (see: www.screening-fab.com)



▲ *EIS characterization of a 10 nm cobalt film immersed in a corrosive medium: phase shift due to corrosion and corrosion inhibition*



▲ *Image of a 10 nm cobalt film immersed in a corrosive medium without (up) and with (down) corrosion inhibition treatment*



▲ *SEM cross-section image of a Li containing anode layer stack for micro and nano batteries*

ADVANTAGES AT CNT

- ***Electrochemical research specifically aligned to microelectronic engineering***
  Integration of electrochemical based functionalities and technologies into the field of microelectronics
- ***Lab-to-Fab services***
  Fundamental tests, feasibility studies, development of materials and technologies in lab environment, scale up for microelectronic integration and production under industry standard fab conditions
- ***Network collaboration***
  Vast collaboration and research network along the value added chain for a wide scope of applications (Fraunhofer Group for Microelectronics, foundries, supplier, universities)
- ***Interdisciplinary team of scientists and engineers***
  Over 10 years of experience in transferring technologies and processes into microelectronics (e.g. nanotechnology, energy harvesting/storage and electrochemical sensing)

APPLICATION EXAMPLES

- ***Thin film depositions***
  Multipurpose coating services for: Ag, Al, Au, Co, Cu, Li, Ni, Sn, Ta, Ti, …
- ***Copper plating***
  Test and scale up of chemical packages for BEoL/BE, TSV, metallization: Damascene, WLP, ELD, evaluation of test structures; investigations on electrolyte-seed-interaction
- ***Deposition and characterization of electrochemical active materials and deposition process development***
  Battery materials for nanobatteries and active RFID, sensor materials for MEMS-pellistors and MOX-sensors
- ***Electrochemical functionalization and modification***
  Integration of nanotechnology into microelectronics (carbon nanotubes in CMOS)
- ***Corrosion investigations and inhibition in semiconductor fabrication***
  Chemical-substrate-interaction in wet processes (surface clean, chemical-mechanical planarization, plating)

ANALYTIC CAPABILITIES

- ***Thin films***
  Thickness & resistivity measurements (electrical, optical), impurity analysis (ToF-SIMS, EDX), optical inspection (OM, SEM, TEM)
  - Especially metals: phase & phase transformation investigations (XRD, XRR, XPS)
  - Especially insulators: capacity & k-value determination (Impedance Spectroscopy), porosity measurements
- ***Batteries / battery material testing***
  Electrical & electrochemical characterization (EIS), various cycling and stress tests (CLD, PCGA, GCPL, CVS, …)
- ***Corrosion investigation***
  Determination of corrosion potentials, currents and kinetics in solid-liquid systems (LP, CM, CVS, EIS, …) functionality evaluation of corrosion inhibitors and films (EIS), corrosion damage analysis in micro- & nanometer-scale (EIS, SEM, XRD, EDX, ToF-SIMS)
- ***Liquid phase analysis***
  Monitoring and degradation investigations of chemical packages for electrolyte and additives (CVS), investigation of additive adsorption kinetics (CVS, EIS, potentiostatic and galvanostatic measurements)

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Fraunhofer IPMS SCREENING FAB

DEKRA Quality Management ISO 9001

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