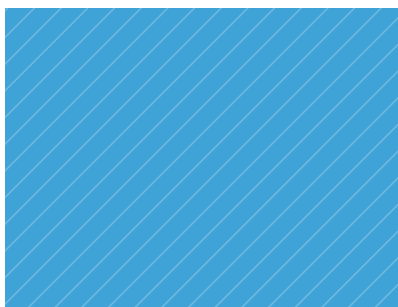


RESEARCH GROUP CONTACT >>

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THEMATIC RESEARCH FOCUS >

RESEARCH AREA

- » Scanning electron microscopy

EXCELLENCE

- » BSE and SE detectors with scintillation single crystals, detection systems for VP-SEM, ESEM

MISSION

We want to maintain and further develop our position among the world's leading workplaces.

DEVELOPED TECHNOLOGIES >

CONTENT OF RESEARCH

- » Physical processes of interaction mechanisms at collisions of electrons with gas molecules
- » Ways of electron scatter in gaseous media
- » Differential pumping as well as gas flow computation in microscopes VP-SEM and ESEM
- » Problems of electron scatter in the dependence on the gas medium pressure.
- » Scintillation of single crystals for detection of signal electrons in SEM, ESEM and TEM

Fig 1 Environmental scanning electron microscopy AQUAEM II

Fig 2 Detail of pollen surface structure. Ionization detector AQUASEM II microscope, a sample without any modifications

MAIN CAPABILITIES

Basic research

- » Study of kinetics of single crystal scintillators
- » Study of mechanisms for the creation and multiplying of signal electrons in an environment of high pressure gas and simulation of these phenomena
- » Study of samples in terms of dynamic in-situ experiments

Application research + protection forms

- » New types and features of the detectors for REM and EREM
- » Electrochemical sensors
- » Solar cells
- » Stem cells and other biological samples

FIELDS OF RESEARCH RESULTS APPLICATION

Fields of research results application

- » Life sciences (especially molecular biology, biochemistry)
- » Material science (study of some special samples)
- » Measuring instruments
- » Renewable energy
- » Plastics, polymers
- » Glass, ceramics
- » Textile industry



NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

3

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

3

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

Laboratory of environmental scanning electron microscopy:

- » Observation of the process of electrically non-conducting specimens without covering them with a conducting layer on the surface

If the gas pressure in the specimen chamber of EREM is higher than 200 Pa, the primary and signal electrons collide with atoms and molecules of gases in the vicinity of the specimen and thus the originating ions compensate for charging of the specimen by incident electrons. Through this process electrically non-conducting specimens can be observed and yet their surface need not be covered with a conducting layer. If the pressure of gas, or rather water vapour, in the specimen chamber is higher than 611 Pa (at 0°C), objects containing a certain amount of water do not dry up and collapse, and therefore are suitable for observation.

»

Experimental non-commercial VP-SEM AQUASEM II equipped with a moisturizing system and cooled specimen holder. The VP-SEM can be used to study:

- » Details of the surface structure of conducting and non-conducting natural animated and inanimate specimens
- » Wet specimens and specimens on the boundary of states (condensation, evaporation, meeting, solidification, etc.)
- » Specimens in conditions of mechanical and thermal strain in the vacuum or gas of optional humidity
- » Material, topographic or voltage contrast due to which imaging of electric charge accumulation and distribution e.g. on transistor gates is possible
- » Reactions of various chemical substances in the specimen chamber
- » Aggressive chemical substances, e.g. battery mass
- » Various types of specimens in conditions closely approximate to atmospheric pressure

Unique detection systems in the world:

- » Specially designed single crystal scintillation detectors using the YAG and YAP scintillator – design, development and study of physical properties of custom-built systems.
- » Unique detection systems for high pressure conditions of VP-SEM or ESEM. (detection systems are based on the gas-ionisation phenomena enabling high amplification of the detected signal) Two new detection systems have been developed and patented in the last three years.

BUDGET ↘

TOTAL (MIL. CZK)

3

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

40

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS ↘

2010–2013: The study of the influence of magnetic and electric fields for amplification of secondary electron signals detected by a novel detector in VP-SEM (project GAP102/10/1410 financed by the Czech Science Foundation)

2009–2013: Application of Laser Technologies into the Process of Crystalline Silicon Solar Cells Production (project FR-TI1/305 financed by the Ministry of Industry and Trade)

2009–2013: New generation of electrochemical sensors and biosensors using thin modified DLC layers (project FR-TI1/118 financed by the Ministry of Industry and Trade)

ACHIEVEMENTS

European patent

- » Neděla, Vilém; Jiráček, Josef: Ionisation detector of an environmental scanning electron microscope, Institute of Scientific Instruments, Academy of Sciences of the Czech Republic, EP 2195822 (A2), Publication date 2010-06-16.

Scientific results of the team members are regularly published in high profile scientific journals

- » Jiráček, J., Neděla, V., Černochoch, P., Čudek, P., Runštuk, J.: Scintillation SE detector for variable pressure scanning electron microscopes. *Journal of Microscopy*. 239, 3 (2010), p. 233-238. ISSN 0022-2720
- » Neděla, V., Weyda, F., Černochoch, P.: Advantages of Study of Amber Fossils with Ionization Detector in Variable Pressure SEM. *Microscopy and Microanalysis*. 13, Suppl. 3 (2007), p. 250-251. ISSN 1431-9276
- » Neděla, V.: Methods for Additive Hydration Allowing Observation of Fully Hydrated State of Wet Samples in Environmental SEM. *Microscopy Research Technique*. 70, 2 (2007), p. 95-100. ISSN 1059-910X
- » Ježek, J., Čížmár, T., Neděla, V., Zemánek, P.: Formation of long and thin polymer fibre using nondiffracting beam. *Optics Express*. 14, 19 (2006), p. 8506-8515. ISSN 1094-4087



MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- » University of Cambridge (Cambridge, GB)
- » Westfälische Wilhelms-Universität (Münster, DE)
- » University of Western Australia (Perth, AU)
- » Institute of Scientific Instruments, Academy of Sciences of the Czech Republic (Prague, CZ)
- » Faculty of Mechanical Engineering, Brno University of Technology (Brno, CZ)
- » Faculty of Medicine, Masaryk University (Brno, CZ)

COLLABORATION WITH COMPANIES

- » BVT Technologies (Brno, CZ)
- » Solartec (Rožnov pod Radhoštěm, CZ)
- » Tescan (Brno, CZ)
- » Crytur (Turnov, CZ)
- » Delong Instruments (Brno, CZ)
- » Hitachi (JP)
- » Jeol (JP)

EXPECTATIONS ↘

REQUIREMENTS

- » Suitable industrial partners
- » Collaboration with biologists, doctors and others
- » New and high-quality postgraduates
- » Motivate / initiate / help companies to arrange scholarships for graduates / postgraduates

OFFERS

- » Long term experience with design and production of scintillation single crystal detectors for detection of backscattered electrons and secondary electrons for SEM and ESEM
- » Long term experience in the field of environmental SEM (study of non-conductive and highly wet samples)
- » Cooperation with commercial partners in the field of diagnostics of materials using scanning electron microscopy