



Prof. Dr. Pavel Javorský

Department of Condensed Matter Physics
Faculty of Mathematics and Physics
Charles University
Ke Karlovu 5
121 16 Praha (Prague) 2
The Czech Republic

Cologne, August 23 2022

Mathematisch-
Naturwissenschaft-
liche Fakultät

II. Physikalisches Institut

Prof. Dr. Mohsen. Abd-Elmeguid

Report of the Scientific Advisory Committee of the Materials Growth and Characterization Laboratory (MGML) research infrastructure

Telefon +49 221 470 2625
meguid@ph2.uni-koeln.de
www.ph2.uni-koeln.de

The Scientific Advisory Committee (SAC) of the Materials Growth and Measurement Laboratory (MGML) research infrastructure (RI) has been invited by the head of MGML, Professor Pavel Javorský, for a meeting in Prague to visit MGML and to discuss several issues related to the recent developments and the next long term funding of the RI.

On June 8, 2022 the SAC members visited the technology and X-ray laboratories of the Materials Growth and Characterization Laboratory (MGCL) in Karlov and the Material Properties Measurement Laboratory (MPML) in Troja. The visit included guided tours to the Labs with presentations of the responsible scientific staff members and discussion with the SAC. At the end, Pavel Javorský gave a useful presentation about the current status of MGML with a focus on the result of evaluation of the project for the next long term funding (2023-2029) and the expected budget cuts. Jiří Pospíšil and Jan Prokleška presented the recent developments and investment plans of MGCL and MPML. The scientific highlights were presented by Master and PhD students. The presentations were followed by an extensive discussion with all responsible scientific staff members. After the visit, the SAC met together and discussed the overall impression of the recent development of MGML as well as the possibilities to compensate the expected budget cuts. All SAC members participated in editing the final report.

Overall impression:

a- Scientific members/ structure of MGML

The SAC was very impressed by the presentation of the scientific members through the tour guides, particularly by the contribution of more young scientists. They were all very enthusiastic and genuinely involved into the activities of their labs and facilities. The SAC strongly appreciates such improvement of the age profile in MGML, leading to much more horizontal structure of the group of people involved into the research infrastructure. This is a major progress of MGML towards a modern and sustainable international research infrastructure.

Zülpicher Str.77
50937 Köln
Telefon +49 221 470-5819
Telefax +49 221 470-5178

Sekretariat : Frau Handels
handels@ph2.uni-koeln.de

b- Science

The SAC was more than satisfied with the significant growth of the MGML capacity for experimental research - and not just through the partial integration of the existing X-ray lab equipment (e.g. small angle scattering and high resolution x-ray diffraction), but also through the growth of the MGCL and MPML labs that formed the core of the original MGML facilities. **MGML** made a noticeable progress toward broadening as well as improvement of the research quality of the infrastructure for the benefit of the users.

MGCL is now able to synthesize and characterize broad classes of materials (e.g. intermetallic materials, salts, and oxide based materials) in polycrystalline form and as single crystals after successful installation of the following instruments:

- new two-zone furnace for the production of samples by chemical vapor transport (CVT).
- floating zone – laser furnace
- high-temperature vacuum sapphire furnace.
- New support instruments for precise cutting and polishing of samples with a low surface roughness.

Also the planned investments to replace the 20 years old Tescan SEM-EDX instrument (accuracy ~1%) by the MIRA 3 Field Emission Gun Tescan apparatus that increases the accuracy of quantitative chemical analysis of samples by an order of magnitude (~0.1%) is highly appreciated.

MPML extended the range of the external parameters and improved the quality of measurements procedure by:

- The addition of new vector magnet and dilution refrigerator which allows to perform measurement down to ~8 mK and up to magnetic field of ~ 6 T.
- Refurbishment of the original dilution refrigerator which has a 9T cryostat; the lowest temperature is 20-30mK with the option to use it in the 20T cryostat.
- Finishing and testing the wide band (sub Hz to MHz) for measurement of the electric permittivity in 20T cryostat down to 0.3K.

Also the planned investments to replace the core instrumentation of the old PPMS by a new 14T system + supporting 9T is strongly appreciated.

Here, the SAC would like to notice that such an **expansion in the metrology** is extremely important and timely as smaller research groups often lack manpower and experimental capacity together with the related additional maintenance and running costs. Possibility to access such equipment at MGML will be an important added value for users.

One comment regarding science: Not much was mentioned about the theoretical support for the research although clearly some of the presented research was done in collaboration with theoreticians. We applaud and recommend when MGML with its wide-ranging network can support 'matchmaking' between the experimental team with theory colleagues to mutually benefit a specific project / proposal.

Suggestions for exploring additional funding possibilities to compensate the expected budget cuts:

The SAC advocates that a more proactive approach should be adopted for engaging industrial collaboration. This should involve informing industry not as much as about the instrumentation and facilities but about the **expertise available** in conducting the measurements, analyzing the data and coming up with recommendations.

Suggested areas of collaboration with industry is in **materials research and materials selection** in general and in particular in the areas of:

- **Sensors for extreme conditions:** robotics for deep earth mining, nuclear power stations maintenance, military as well as civilian drones, etc. This is where the availability of extreme temperatures, fields and pressures and various measurements at these conditions would come handy.
- **Materials for quantum technologies** (quantum computing materials, etc.). This is where all the MGML expertise in electronic and magnetic materials and measurements would be useful.
- **Organization of workshops** would help to explore their methodological demands (sample qualities, sizes, parameter range and precision), and discuss possible options for scientific cooperation to create long term industrial partnerships.

On the behalf of the Scientific Advisory Committee of MGML

Prof. Dr. Mohsen Abd-Elmeguid (Chair)

