ILIE MURGULESCU INSTITUTE OF PHYSICAL CHEMISTRY OF THE ROUMANIAN ACADEMY. A BRIEF (HI)STORY.

Vlad Tudor Popa

Founding, growing and entangled administrative trajectory

The beginning of organized physical chemistry research in dedicated entities, outside Roumanian universities, was initiated in 1949. The "Section of Physical Chemistry" was created within the Romanian Academy Institute of Physics, located at Magurele. In 1954 this section was transferred at the "Chemical Research Center" of the Academy with the aim to gather all chemistry basic research units in Bucharest. The section operated at the Chair of Physical Chemistry of the Bucharest University from 1954 to 1962 when it was moved into its first allocated building in 23, Dumbrava Rosie Street.

Faced with the natural expansion of the Chemical Research Center, the Romanian Academy Presidium decided on October 1st 1963 its splitting into the following three research units: Center of Inorganic Chemistry; Center of Organic Chemistry; Center of Physical Chemistry. This transition took place under the supervision of Professor Ilie Murgulescu, which was appointed as the first director of the Center of Physical Chemistry, a position that confirmed his scientific reputation and his role in the development of systematic physical chemistry education and research in Romania.

Fig. 1. Professor Ilie Murgulescu, founder of the Center of Physical Chemistry of the Romanian Academy (at present Institute of Physical Chemistry).

A group of devoted and enthusiastic researchers, most of them educated and trained under the direct supervision of the Professor, was the growing nucleus of the newborn research center. Its members may be adequately described as "the first sphere of coordination", as young Ilie

Murgulescu accomplished his PhD studies in Cluj, under the supervision of Professor Gheorghe Spacu, with a thesis in coordination chemistry. We may mention, among this "inner sphere" members, Stefania Zuca, Dumitru Marchidan, Iuliana Vartires, Niculae Ionescu, Maria Zaharescu, Mihai Vass. Following Professor Murgulescu's modern views of education and research twinning, several of his university followers lead research directions and groups within the Center of Physical Chemistry: Victor-Emanuel Sahini, Eugen Segal, Octavian Radovici.

Fig. 2. 1963: Foundation of the "Center of Physical Chemistry". Dr. Dumitru Marchidan and Dr. Mihai Vass at the inauguration of the first dedicated building, 23 Dumbrava Rosie Street.

Numerous chemistry and physics young graduates of (mainly but not exclusively) the University of Bucharest joined this group. They were attracted by the prestige of the Bucharest school of physical chemistry and the stature of its leader. Professor Murgulescu offered his consistent presence, support and guidance. The accelerated growing of the new research center, similar to a crystallization process with "seeding nuclei", was led by Professor Ilie Murgulescu with a firm hand and an outstanding vision. He devised the main research directions and set up the structural framework of the Institute of Physical Chemistry, developed under his direction (1963 - 1977) and preserved with some revisions for over 50 years.

An essential and most needed step in the evolution of the institute was the erection of a new building located at 31, Vasile Lascar Street. This was accomplished, under the Professor's supervision, within a five years period, 1965 – 1970. This was the greatest achievement, and later on the most painful losses of the Institute of Physical Chemistry. During the 1970ties the Ceausescu couple gained more political and administrative power, the rising level of which was matched only by their incompetence. Professor Murgulescu stood against the increasing number of aberrant decisions concerning the education and scientific research. For political reasons, due to Professor Murgulescu's firm position against dictatorship, the institute was forced into a sinuous administrative trajectory, eventually resulting in the loss of its dedicated building and legal personality.

In 1970 the Center of Physical Chemistry was subordinated to the Ministry of Education, then, in 1975, to the Ministry of Chemistry and Petrochemistry. In January 1977 professor Constantin Luca replaced by professor Murgulescu at the direction of the institute. In March 1977, after the great earthquake that hit Bucharest, the institute was abusively forced (on fabricated motives of seismic safety) to leave the Vasile Lascar building. It was moved to the actual location,

202 Splaiul Independentei, and incorporated into the Bucharest Central Institute of Chemistry (ICECHIM). In those times E. Ceausescu was the general director of ICECHIM. In spite of these shortcomings, the research staff was able to survive and develop professionally and got ready for the major changes of the year 1990.

Fig. 3 1970ies - The "erected from the scratch" IPC building of 31 Vasile Lascar Street. This building was demolished in 2006.

After the fall of the communist dictatorship, in January 1990 the general assembly of the researchers adopted a resolution requesting the re-affiliation of the institute to the Romanian Academy. A similar approach was followed by many research entities, formerly subordinated to the Romanian Academy. In April 13th 1990, by the Romanian Government Decision Nr. 400, the "Center of Physical Chemistry" was subordinated to the Romanian Academy under the name "Institute of Physical Chemistry" (IPC). Professor Ilie Murgulescu had a decisive contribution to the return of IPC back to the Romanian Academy. After his passing away in October 1991, Academician Ilie Murgulescu made the last and unanimously expected gift to the Institute of Physical Chemistry: his name. In November 1991 the Scientific Council proposed a name change that was approved by the Academy Presidium. The official name of our institute, valid to the present time, is: "Ilie Murgulescu" Institute of Physical Chemistry of the Romanian Academy. Between 1990 and 2012 the institute was led by Mihai Vasile Popa who detained the longest directorship in IPC history, followed by Vlad Tudor Popa (2012 – 2021) and, from May 2021, by Ioan Balint. Between 1995 and 2017 professor Victor Emanuel Sahini was the Honorary Director of the Institute of Physical Chemistry.

Revival of the institute: "Investment for your future" within the INFRANANOCHEM project

This inspired slogan was chosen by the Romanian **Ministry of the Economy**, the **Management Authority** for the **Sectorial Operational Program "Increase in Economic Competitiveness"**. The main purpose of this section is a partial listing the most important achievements within the

INFRANANOCHEM project (2009 – 2011). Major changes in the research infrastructure of the Institute of Physical Chemistry occurred in these two intense, and sometimes exhausting, years. The management and support teams that worked together during this period of time experienced unknown and unexpected challenges: from public procurement intricate issues, through sizable amount of paperwork, up to successfully defending our position to the Appeal Court for the most important public tender organized. Eligible costs of the ***INFRANANOCHEM PROJECT*** were co-financed by the **European Union** through the **European Regional Development Fund - ERDF** (76.7%) and the **Romanian Government** (23.3%), within **Structural Instruments 2007-2013**. The Intermediate Organism General Direction of the National Authority for Scientific Research supervised the project entitled: *Modernizing the research and development infrastructure within the „Ilie Murgulescu" Institute of Physical Chemistry of the Romanian Academy, with extension of the interdisciplinary research in the field of nanomaterials and nanotechnologies.* **Managing team** was: Dr. Vlad T. Popa (Director), Dr. Speranta Tanasescu, Dr. Dan Anghel, Dr. Victor Fruth, Dr. Marieta Balcan. The **Project thematic area** was Innovative materials, products and processes. The main **Research directions** was:
1. Advanced materials composite and multifunctional materials with applications in new sources of energy, electronics, optoelectronics, catalysis sensors, magneto resistive devices and hybrid devices – with 14 specific themes
2. Characterization of biologically interesting compounds and the study of bio / non-bio interactions in dynamic and equilibrium conditions with applications in nanomedicine (drug delivery, nanodiagnosis) and nanobiotechnology - with 10 specific themes
3. Dispersed systems, thin films and gas-solid, solid-liquid and liquid-liquid interfaces - with 9 specific themes

Main scientific equipment purchased
Electron and probe scanning microscopy

- **FEI Tecnai G2-F30:** high resolution electron transmission microscope (TEM, maximum accelerating voltage 300 kV)
- **FEI Quanta 3D FEG:** Dual Beam system that combines traditional thermal emission Scanning Electron Microscopy (SEM, point resolution of 1.2 nm)
- **PARK XE-100 atomic force microscope (AFM):** LFM (lateral force microscopy), phase imaging, MFM (magnetic force microscopy), EFM (electric force microscopy), nanolithography, nanoindentation, liquid cell

X-ray spectroscopy and diffractometry

- **Rigaku Ultima IV multipurpose X-ray diffraction system (XRD):** two-dimensional detector, D/teX-25 allowing for ultra-high sensitivity and speed X-ray diffraction and XRD with areal resolution; HT 1500 high temperature attachment that may be operated in air, gas, vacuum, or under liquid nitrogen cooling conditions
- **Rigaku Sequential X-ray Fluorescence Spectrometer (ZSX PrimusII):** wavelength dispersive X-ray fluorescence spectrometer; element applicable analyses from ^{4}Be to ^{92}U; micro-point analysis with spots as small as 500 microns and with high sensitivity; automatic program operation function
- **ULVAC-PHI X-ray photoelectron spectroscopy (XPS) system:** SEM-like imaging; high-performance micro-(beam spot <9μm) and macro-area (beam spot >200μm) spectroscopy; sputter depth profiling; automated angle dependent depth profiling; point XPS, line XPS and area chemical state XPS imaging

Spectroscopy

- **Horiba Jobin Yvon LabRamHR Raman spectrometer:** UV-VIS, NIR and open microscope capable of single point analysis, automated multi-point analysis, and full mapping capabilities
- **Edinburgh Instruments Combined steady state and lifetime fluorimeter FLS920:** signal-to-noise ratio > 6000:1, resolution from 0.05 – 18nm, lifetimes from 100 picosec to 10 microsec, count rates of up to 100 MHz, high dynamic range and temporal resolution, time correlated single photon counting
- **ABL&E-JASCO Circular Dichroism Spectrometer JASCO J-815:** wavelength range: 163-900 nm; Xenon lamp 150 W; wavelength accuracy: 0.2 nm (163-180nm), 0.1 nm (180-250nm), 0.3 nm (250-500nm), 0.8nm (500-800nm); scan speed: 1-10000 nm/min
- **Thermo Scientific Nicolet iN 10 Continuum Infrared Microscope:** spectral range 7800-450 cm^{-1}; automatic reflectance/transmission sampling modes; resolution: 0.4 cm^{-1}; signal/noise ratio: better than 35 000:1 vv (1min)
- **Thermo Scientific Nicolet iS 10 FT-IR Spectrometer:** auxiliary module with TGA interface, allowing the connection to SETARAM DSC-TG/DTA Setsys Evolution; 7800-350 cm^{-1} optimized, mid-infrared KBr beam splitter; 11000-375 cm^{-1} XT KBr extended range mid-infrared optics
- **VARIAN CARY 300 BIO UV-VIS Spectrophotometer:** 190 to 900 nm wavelength range; pre-monochromator; sealed optics; variable slits; Peltier-controlled, multicell holder system

Thermal analysis and calorimetry

- **SETARAM Calvet C 80 calorimeter:** highest precision ensured by 3D Calvet sensor; 20-300°C temperature range; pressure tight up to 350 bars; measurements under vacuum; batch or semi-batch mixing for solids in liquids or liquids in liquids
- **MicroCal iTC_{200} Isothermal Titration Calorimeter:** most sensitive isothermal titration calorimeter designed for the needs of life sciences; sub-millimolar to nanomolar binding constants (10^2 to 10^9 M^{-1}); nanomolar to picomolar binding constants (10^9 to 10^{12} M^{-1}) via competitive binding technique
- **SETARAM differential scanning microcalorimeter MicroDSC VII:** ultra-sensitive 3D sensor with 0.04 µW calorimetric resolution; Peltier calorimetric block with operating temperature range -45 - 120°C
- **TA Instruments 6300A Nano-Differential Scanning Calorimeter:** active cell volume ~ 0.3 ml; non-reactive chemical resistant Pt cells; temperature range of –10ºC to +130ºC
- **Perkin Elmer power compensated differential scanning calorimeter DSC 8500:** operation temperature range -150 - 750°C; controlled heating and cooling rates from 0.01 to 750 ˚C/min; intracooler accessory

Chromatography

- **Agilent liquid chromatograph system with 6100 Series Quadrupole Mass Spectrometry Detector - LC-MS:** settable column flow range: 0.01 – 4 µL/min; composition precision: < 0.2 % SD, at 500 nL/min; pressure range: 20 to 400 bar
- **Agilent 1260 Infinity high performance liquid chromatograph system – HPLC:** quaternary pump and degassers with flow range: 0.2 - 10.0 mL/min; flow precision: 0.07%RSD; flow accuracy: +/- 1%; pressure range: 20 to 400 bar; pH range: 1.0-12.5
- **Agilent 7820A gas chromatograph system with 5975 Mass spectrometry detector GC-MS:** inlet module - pressure setpoint and control precision to 0.01 psi; flow sensor accuracy: < ± 5%; detector module accuracy: 8% of set-point
- **PerkinElmer Clarus 600 Gas Chromatograph:** TCD (thermal conductivity detector) and FID (flame ionization detector)

Adsorption

- **NOVA 2200e – high-speed surface area and pore size analyzer:** fully automated, vacuum volumetric, and gas sorption system; surface area range: 0.01 m^2/g to any upper limit; pore volume: detectable limit less than 0.0001 cc/g
- **Micromeritics - accelerated surface area and porosimetry system - ASAP 2020:** HighVac™ high vacuum, 10mmHg transducer; micropore (1 mmHg transducer); enhanced chemical resistance; water vapor adsorption; chemisorption measurements facilities

Magnetometry

- **Lake Shore fully integrated vibrating sample magnetometer (VSM):** single stage variable temperature (SSVT) assembly, autorotation and Helmholtz coil; magnetic data from 77 K to 950 K; variable magnetic field (0 – 21700Oe)

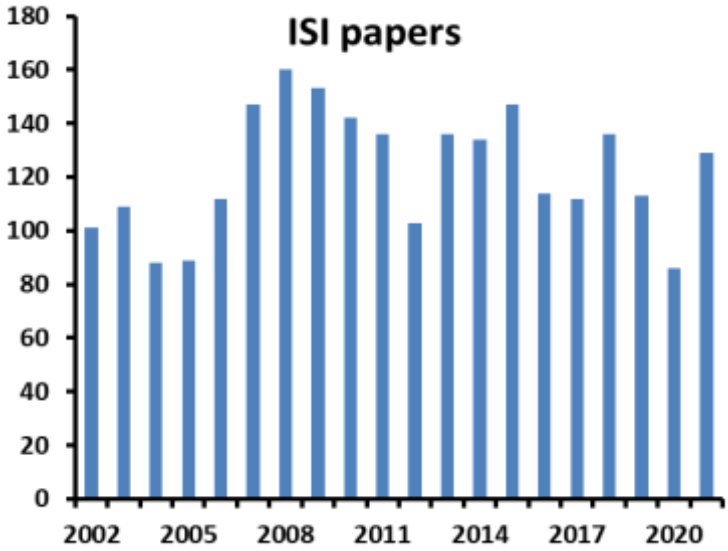
Clean room

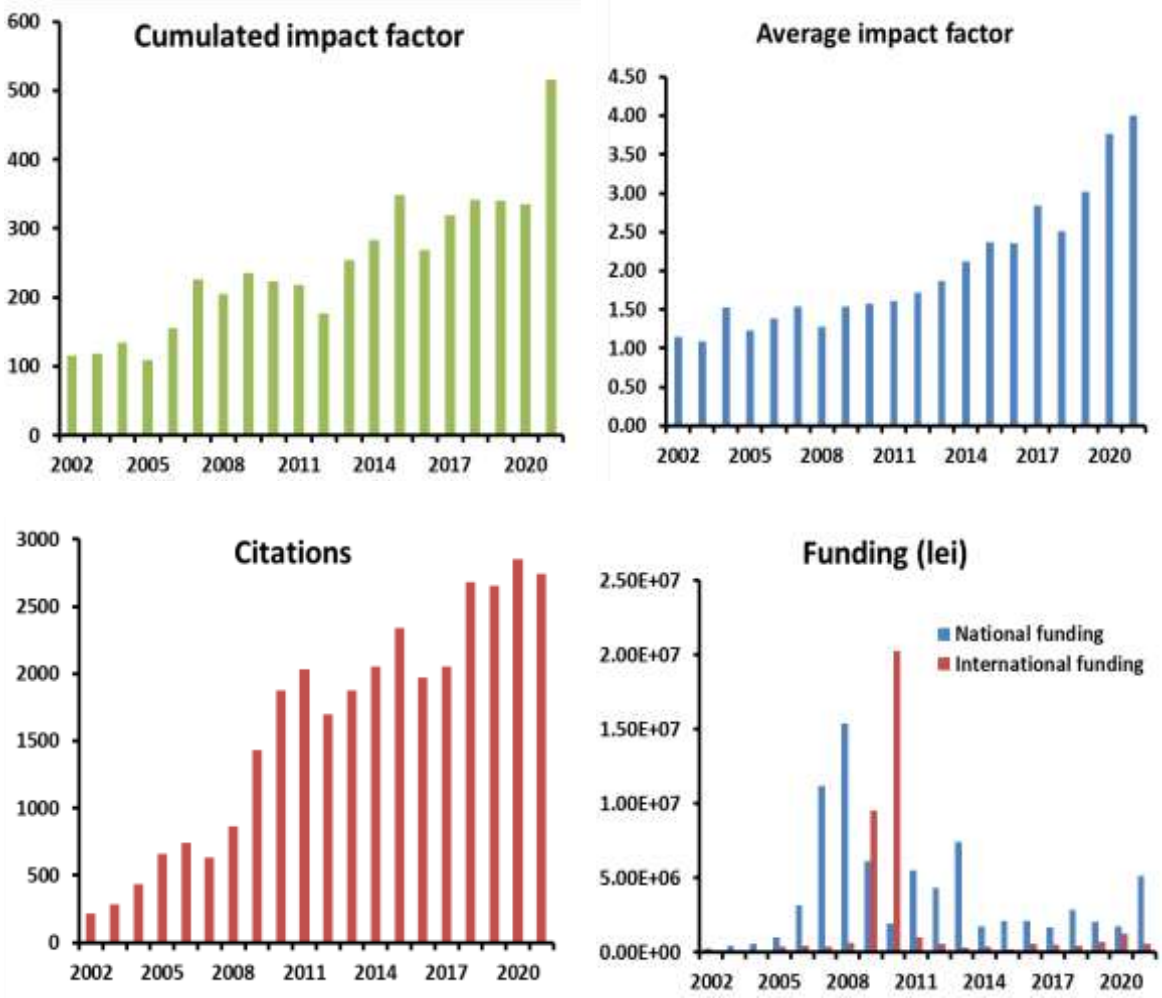
- **Modular clean room type SBM Class ISO 7:** Room dimensions: 4.36 x 6.87 x 2.40 m (high internal) - including 8 m^2 dressing area; 22m^2 room surface

Main Research Results. A 20 years statistical survey.

The Institute of Physical Chemistry of the Romanian Academy, as many other research units, was ready for insertion into national and international research networks and to comply with the required standards. The following graphs and comments are intended to evidence our efforts towards productivity and competitiveness. In terms of a previously advanced motto, "*concuro ergo sum*", the presented data is meant to prove our very existence. The graphs presented below reflect main aspects of the IPC research efforts extended over the last twenty years.

Publication in peer-reviewed journals represents our main activity. Within the Romanian Academy this was a long-term criterion for evaluation of its "exact sciences" institutes. The trend of published ISI papers naturally follows the national research funding policy. There were more or less extensive periods of time when we had to spend more effort in the elaboration of research projects involved in hard competition. This is reflected in the fluctuations of the number of published papers (quantitative indicator). In general, the normal trend (more projects - more papers) is obeyed.





The same trend is evident in the cumulated and average impact factor (qualitative indicators) of the published scientific papers. The "quality jumps" evidenced in the above graphs represent a clear confirmation, within a small community of researchers, that investment in scientific research is a correct political (and even politically correct) action.

The number of citations represents a long-term acknowledgment of scientific activity within the peer-reviewed community. The corresponding graph embodies citations of scientific papers older than 2002 and thus reflects a more comprehensive evaluation criterion. The steady growth of cited Institute of Physical Chemistry researchers' papers evidences a solid insertion of our institute within the international scientific community.

The last graph represents the amounts of additional funding (expressed in national currency, RON) obtained from national and international competitions. A general policy within the Institute of Physical Chemistry and other research units of the Romanian Academy was to use the maximum allowed amount of this funding for infrastructure (mostly scientific equipment) improvement. This could be termed a "long-term investment" as it produced sizable results evidenced mainly by the quality of ISI papers: both cumulated and average impact factor of published papers increased, and this growing trend is expected to continue over the next years. The national funding exhibits fluctuations. On one side this reflects our researchers' competing skills but also fluctuations in the Romanian Government policy concerning research and development. A certain "timidity" and a clear lack of experience is manifested in the ability of our researchers to access international, i.e. mainly EU funds, as expressed in the corresponding graph. This was reported as a quite general, larger-scale observable fact with new members of the European Union.

***Ilie Murgulescu* Institute of Physical Chemistry – the present structure**

Administration: Director: Dr. Ioan Balint Deputy Director: Dr. Victor Fruth Scientific Secretary: Dr. Maria Mitu Chief Accountant: Ec. Gabriela Constantinescu 8 Laboratories (departments) Laboratory / Head: 1. Quantum Chemistry and Molecular Structure / Dr. Gabriela Ionita 2. Chemical Thermodynamics / Dr. Speranta Tanasescu 3. Chemical Kinetics / Dr. Adina Magdalena Musuc 4. Surface Chemistry and Catalysis / Dr. Mariuca Gartner 5. Electrochemistry and Corrosion / Dr. Maria Marcu 6. Oxide Compounds and Materials Science / Dr. Irina Atkinson 7. Colloid Chemistry / Dr. Adriana Baran 8. Coordination and Supramolecular Chemistry / Dr. Gabriela Marinescu	Structure of research: Programs: 7; Projects: 24; Themes: 66 Research programs: P1. Thermodynamics and Chemical Kinetics. Quantum Chemistry P2. Catalytic materials and processes P3. Electrode processes, Corrosion and Materials for Electrochemical Systems P4. Materials science and advanced characterization methods P5. Complex Functional Colloids P6. Biomedical and environmental applications P7. Science of surfaces and thin layers Human resources: Scientific researchers I: 27 Scientific researchers II: 29 Scientific researchers III: 54 Scientific researchers: 10 Assistant (junior) researchers: 21 Auxiliary staff: 22 Administrative and technical staff: 24

Closure

Important competitiveness criteria such as the number of ISI published papers, impact factors of the pertaining journals and citations prove the front ranking of the Institute of Physical Chemistry among similar Romanian research institutes and indicate its sizable presence within the European and international scientific community. However, access to the international funding is still far behind the desired level needed for a member of the global research world. The improvement of this situation is expected in the future. We had training opportunities offered by Romanian Government R&D policy change, started in 2005: with important successes in national research funding competitions, we should be able to compete for European and international funds. For many academic researchers, this means the descent from the scientist's "ivory tower" into the "arena" of European and international competition. It is the only way to survive, as active citizens, under "the wind of global change".

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