

# Chemistry

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The Chemistry Department conducts basic and applied research in the areas of Analytical Chemistry, Inorganic Chemistry, Solid State Chemistry, Radiochemistry, Radiopharmacy and Geochemistry. The Department combines a high expertise on the synthesis of inactive and radioactive compounds with impact on health, materials science, and catalysis, with a wide range of techniques for analytical and structural characterization. The development and application of nuclear analytical methods to environmental studies and cultural heritage is also a strong field of research in the Department.

The strategic plan places particular emphasis on the following areas:

**Cultural Heritage and Sciences** – the group focus its research activity mainly on the valorisation and preservation of the archaeological and the geological patrimonies. Archaeometry, geochemistry of the earth surface and geological environment are the main areas of study. During 2003 it is important to emphasize the increment of ceramic archaeometric projects, and the important development on the absolute dating by radiocarbon and luminescence due to the recognition by the scientific community of the good set up of the TL-OSL laboratory.

**Environmental Analytical Chemistry** – the activity of the group is focused in the areas of Environmental Geochemistry, Isotope Hydrology, Palaeoenvironment and Archaeometallurgy, in the framework of projects externally financed and in collaboration with other National and International research teams. During 2003 special emphasis has been placed on the field of Environmental Geochemistry (studies concerning the main Iberian river basins and adjacent continental shelf) and Isotope Hydrology (in relation to the dynamic evolution response of groundwater systems to Human influences and climatic changes).

**Inorganic and Organometallic Chemistry** – the group is concerned with the synthesis, characterization and chemical reactivity, established by means of stoichiometric and catalytic reactions, of *4f* and *5f* compounds. Trimerization of methylcyanide performed by a uranium(III) compound, a new method for the synthesis of copper supported catalysts, the observation for the first time of the “bare” neptunyl and plutonyl ions in gas-phase and an estimate of the unknown  $An^{2+} - O$  and  $OAn^{2+} - O$  bond dissociation energies and  $AnO^{2+}$  ionisation energies by FTICR/MS are some of the most relevant results during 2003.

**Inorganic and Radiopharmaceutical Chemistry** – the research of the group is focused on the design, synthesis and characterization of novel specific radioactive probes for non-invasive molecular imaging and/or therapy. During 2003, new halogen – based

radiotracers have been synthesized and characterized, aiming the detection of ER+ human breast tumours. Concerning metal-based radiotracers, complexes with high IC50 values and specificity for the 5HT1A receptors were isolated. Some of the values found are among the best ones that have been reported. We have also shown the suitability of some of our building blocks for labelling biologically active peptides with affinity for tumour receptors.

**Solid State** – the group focus its research activity on new materials with unconventional electrical and magnetic properties. The group combines a high expertise on preparative chemistry of molecule based conducting and magnetic materials and of intermetallic compounds with a wide range of specialized solid state techniques. During 2003 two chain compounds, reported by the group almost 3 decades ago, were used as model Charge Density Wave (CDW) systems to probe, for the first time, the behaviour of a CDW under large magnetic field.

To pursue these objectives the groups develop and maintain the best possible in-house capabilities: specialized solid state physics techniques, facilities for manipulation of radioactive compounds, FT/ICR mass spectrometry, instrumental neutron activation analysis, EDXRF spectrometry, two absolute dating techniques: radiocarbon and luminescence, and a tritium dating unit and an elemental analyser coupled to one of the two mass spectrometers for light isotopes. Some of these facilities that are unique in the country enables the Department to act as a key partner of national and international research projects.

A major effort of the Department has been the education and training of young scientists. Undergraduate, MSc, PhD and Post-doctoral students account for roughly 50 % of our work force. Training of students and professionals of health is also undertaken due to our specialized existing facilities. During this year researchers of the Department have been involved in advanced training activities in collaboration with the university and in the context of international networks. A MSc course in Biomedical Inorganic Chemistry to begin in 2004 has been organized in collaboration with the university.

These activities have been funded mainly by research projects supported by the Portuguese Science Foundation (FCT) and the European Commission. Protocols, Contracts and Services with other private or public institutions and industry are another source of funding. At the end of 2003 a X-ray powder diffraction facility has been acquired with the support of ITN. Replacement of some equipment and partial rehabilitation of the building has also been supported by ITN.

# Structure of the Sector and Technical staff

## Research groups in the Chemistry Sector

- Cultural Heritage and Sciences
- Environmental Analytical Chemistry
- Inorganic and Organometallic Chemistry
- Inorganic and Radiopharmaceutical Chemistry
- Solid State

## Administrative and Technical staff

- E. C. FLORES
- M. F. MARQUES
- P. M. REIS
- M. F. CABRITA