



# PIXE

MEXICO  
2007

**PROCEEDINGS OF THE  
XI INTERNATIONAL CONFERENCE ON  
PARTICLE INDUCED X-RAY EMISSION  
AND ITS ANALYTICAL APPLICATIONS**

**Editors:**

**J. Miranda, J. L. Ruvalcaba-Sil,  
O. G. de Lucio**

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**IN COLLABORATION WITH  
INTERNATIONAL ATOMIC ENERGY AGENCY  
CENTRO LATINOAMERICANO DE FÍSICA  
SOCIEDAD MEXICANA DE FÍSICA**



# PROCEEDINGS OF THE XI INTERNATIONAL CONFERENCE ON PIXE AND ITS ANALYTICAL APPLICATIONS

## Editors:

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## PIXE 2007 logo

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## Cover Picture

Mosaic at the *Santuario de Nuestra Señora de Guadalupe*, Puebla.  
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# Foreword

The analytical technique X-ray spectrometric method Particle Induced X-ray Emission, (PIXE) is currently applied in many fields of knowledge, enhancing the understanding of the Physics underlying the interaction of ion beams with matter, related to the processes that originate PIXE, as well as the improvements in the instrumentation. For example, the development of the nuclear microprobe was strongly linked to PIXE. The wide capacities of this technique allowed its spreading around the world, so in 1976, the First International Conference on PIXE and its Analytical Applications took place in Lund, Sweden.

After this first encounter, an outstanding tradition was initiated with subsequent PIXE conferences (Lund 1980, Heidelberg 1983, Tallahassee 1986, Amsterdam 1989, Tokyo 1992, Padua 1995, Lund 1998, Guelph 2001, and Portoroz 2004). These meetings shared a common high scientific standard, while they also encouraged the social and cultural exchange among attendants.

The past PIXE Conferences showed the advances in the area. Examples of recent research include the use of high energy proton beams for materials characterization, the study of biological tissues *in vivo*, analysis of extraterrestrial materials, development and application of micro- and nano-beams for PIXE and related techniques, improvements in the X-ray detection systems, and investigations about the basic physical phenomena involved in the application of PIXE. Nonetheless, this research is still posing unanswered questions.

PIXE has been applied in Mexico for almost 30 years. Mexican scientists have participated continuously in the PIXE conferences since Tokyo 1992, so the International Advisory Committee (IAC) accepted the bid of the Mexican groups, presented in Portoroz, Slovenia, in 2004, to organize the Eleventh International Conference on PIXE and its Analytical Applications. This event was held in the city of Puebla, Mexico, from May 25 to May 29, 2007.

The city of Puebla offered a historical environment (both colonial and prehispanic), that enhanced the friendly interaction of more than 110 participants from 27 countries. There were 44 oral presentations in 12 sessions, while a total of 92 posters were displayed in two sessions. Furthermore, two round tables with Archaeometry and Environmental applications as main topics took place, as well as a workshop for the explanation of the new quantitative analysis software GUPIXWIN. The subjects of the sessions were classified as Basic Physical Principles, Advances in Experimental Devices, Biology and Biomedical Sciences, Arts and Archaeology, Environmental Sciences, Materials Science, and Complementary Analytical Methods. The concluding remarks of the Conference were presented by Dr. Geoff W. Grime, Chair of the IAC.

As this was the first time this conference was awarded to a developing country, it was pleasant to have a strong participation of scientists from other emergent nations, especially (but not limited to) countries in Africa and Latin America. This way, the conference allowed the interaction of young scientists and students from these geographical areas with the most prestigious PIXE scientists.

Furthermore, an accompanying persons program, with more than 15 participants, was scheduled, including visits to several interesting places in the surroundings of Puebla. The traditional excursion in the PIXE conferences had to be adjusted in the last minute due to damage produced by a storm to the prehispanic site of Cacaxtla, so the colonial sites of Huejotzingo, Cholula, and San Francisco Acatepec were visited.

As in the case of PIXE 2004 in Slovenia, proceedings for many presented works in PIXE 2007 are published in this volume, electronic format. There was a rigorous refereeing process, in order to maintain or improve the scientific level of other PIXE conferences. Furthermore, the International Advisory Committee selected a limited number of papers for publication in this special issue of *X-ray Spectrometry* (XRS), following the strict refereeing process established by XRS. The publication of these works in this prestigious journal will also benefit those users of PIXE, worldwide, that could not attend the Conference, as well as future scientists.

Although it was not possible to have an exhibit of companies related to the ion beam analysis area, National Electrostatics Corp., High Voltage Engineering, Oxford Microprobes, and John Wiley & Sons supported the Conference. Additionally, the International Atomic Energy Agency and the Centro Latinoamericano de Física sponsored the participation of Latin-American scientists and students.

The proposal presented by the group from the University of Surrey, United Kingdom, headed by Dr. Geoff W. Grime, to host the 12<sup>th</sup> International Conference on PIXE and its Analytical Applications, was accepted by the IAC, in June 2010. We hope this will be an even more successful event than the previous PIXE Conferences.

Only with the support of many people the PIXE 2007 Conference could take place. In particular, it is necessary to mention Dr. Pedro Hugo Hernández-Tejeda and Dr. Ventura Rodríguez-Lugo (Benemérita Universidad Autónoma de Puebla), and their team, especially María del Carmen Herrera; the collaboration of Leonor Báez and Patricia Carranza (Sociedad Mexicana de Física), as well as the hard work of Valter Barrera, Alberto Espinosa and Juan Reyes-Herrera. Finally, the editions of these proceedings and the book of abstracts were mostly due to the invaluable work of Marcelo Lugo-Licona, Raquel Noria, Grisell Reyes and Óscar de Lucio. The support of Dr. Ana Maria Cetto (International Atomic Energy Agency) was always encouraging. Certainly, the group at Instituto de Física, UNAM (José Luis Ruvalcaba-Sil, Corina Solís, Alejandro Crespo-Sosa, Luis Rodríguez-Fernández, Juan Carlos Cheang-Wong, and Alejandra López-Suárez) had a fundamental role in this Conference. Thanks to all of them.

*Javier Miranda*

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- B-3. **Silicon detector deadlayer thickness estimates using proton bremsstrahlung from low atomic number targets.** *D.D. Cohen, E. Stelcer, R. Siegele, M. Ionescu.*
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- C-3. **Micro-PIXE studies of elemental distribution in mycorrhizal and nonmycorrhizal roots of Ni-hyperaccumulator *Berkheya coddii*.** *E. Orłowska, J. Mesjasz-Przybyłowicz, W. Przybyłowicz, and K. Turnau.*
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- D-3. **The identification of historic biocide residues on herbarium material at the National Museum Wales.** *V. Purewal, B. Colston, S. Roehrs.*
- D-4. **Nuclear microprobe studies of grasshopper feeding on nickel hyperaccumulating plants.** *M. Augustyniak, W. Przybyłowicz, J. Mesjasz-Przybyłowicz, M. Tarnawska, P. Migula, E. Głowacka, A. Babczyńska.*
- D-5. **Daily changes of elemental concentration in a human body over 218 days obtained by quantitative analyses of beard samples.** *K. Sera, J. Itoh, Y. Saitoh and S. Futatsugawa.*

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- I-2. **Chemical composition and mass closure for PM<sub>2.5</sub> and PM<sub>10</sub> aerosols at K-puszt, Hungary, in summer 2006.** W. Maenhaut, N. Raes, X. Chi, J. Cafmeyer and W. Wang

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- PI-12. Development of an ion microprobe setup for complex elemental analysis of individual microparticles. *Zs. Kertész*, *A. Simon*, *Z. Szikszai*, *E. Dobos*, *G. Á. Sziki*, *I. Uzonyi*.

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- PI-23. **PIXE and  $\mu$ -PIXE analysis of biological records in environmental studies.** *L. Calcagnile, K. Butalag, G. Quarta, L. Maruccio.*
- PI-24. **Effects on the elemental concentration in growth tree ring due to Popocatepetl volcano exhalations.** *A. R. Cruz-Muñoz, L. Rodríguez Fernández, G. Calva-Vázquez, and J. L. Ruvalcaba-Sil.*
- PI-25. **Relationship between soil composition and the distribution of three *Manfreda* (Agavaceae) in Mexico.** *N. Martínez-Nava, R. Ríos-Gómez, E. Solano-Camacho, M. Ayala, L. Rodríguez Fernández, J. Reyes-Herrera and L. Caballero-Pagaza.*
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