



El Instituto Mexicano del Petróleo



World-class Lab Built to Develop New Materials for the Oil Industry

Titan™ Scanning/Transmission Electron Microscope plays key role in patents obtained by the Ultra-high Resolution Electron Microscopy Lab

Mexico's Instituto Mexicano del Petróleo (IMP/Mexican Institute of Petroleum) is a federally founded institution dedicated to basic and applied scientific research, and to the development of new technologies applicable to the oil industry. IMP assists in the search for new oil deposits through the improvement of exploitation methods. IMP also helps improve the production of high-quality fuels, and train the specialized personnel. Ultra-high Resolution Electron Microscopy Lab was modernized, with the following objectives:

- To create a world-class electron microscopy lab equipped with the highest resolution imaging technology
- To play a key role in the research and development of nanocatalysts for more efficient fuels, fuel cell membranes, and new nano-enabled materials such as anticorrosive products for oil refineries and pipelines
- To contribute to the control of critical intellectual property for new materials and maintain patent protection

“Having a fully equipped FEI Titan was critically important to obtaining three important IMP patents.”

— Vicente Garibay
IMP Transmission Electron Microscope Specialist and Executive Manager of the Ultra High Resolution Electron Microscopy Laboratory

Electron microscopy began at IMP in 1965 when the Institute was founded to study both sub-soil sampled and lab-developed materials. In 2006, modernization of the lab was completed with the acquisition of a Titan, a top-of-the-line transmission electron microscope.

The Challenge

Before the lab modernization in 2006, IMP had wide-ranging cooperative agreements with other institutions and universities to process and characterize materials. “The issue we were facing was the protection of new discoveries, and their intellectual property rights,” says Vicente Garibay, IMP Transmission Electron Microscope specialist and Executive Manager of the Ultra High Resolution Electron Microscopy Laboratory. After few years, it became clear that IMP could not control the intellectual property rights without owning the tools that enabled the discoveries. In addition, sometimes research results were less than satisfactory because the contact labs did not have the most advanced microscopy tools.

Why FEI?

For IMP, the search for the right tools to equip the lab boiled down to this simple equation:

“We want to obtain results fast and with good quality. To be successful, you need three things—a good specialist, the newest and best tools, and a good sample. FEI provided IMP with the best tools to obtain and characterize good samples,” says Garibay.

“Before we decided which equipment to purchase, we did significant research, holding meetings with colleagues around the world to investigate the newest and best technology. We wanted to buy for the future. At the end, we acquired five FEI tools,” says Garibay. IMP’s state-of-the-art lab features: a FEI’s XL 30 environmental scanning electron microscope (ESEM), a Nova 200 NanoLab™ (the first DualBeam™ installed in Latin America), two Tecnai™ transmission electron microscopes (TEM), and the FEI’s flagship product, the Titan™ S/TEM, the world’s most powerful commercially-available microscope.

“Once we decided to go for the Titan, the next challenge was staging the equipment in the right conditions. We are located in the north part of Mexico City where trucks driving by induce significant vibration to the buildings,” explains Garibay.

“Throughout the planning process for our new center, we focused on selecting tools that would deliver ground-breaking results and reliability to our researchers and developers working on a wide spectrum of projects,” explained Dr. Marcelo Lozada y Cassou, director of IMP’s Molecular Engineering Program, at the lab’s inaugurating ceremony. “With FEI’s proven solutions, history of technology innovation, and excellent record for customer support, we believe IMP’s center is well positioned for the future.”

The Solution

A primary research area for IMP is catalysis. With world-class research tools and methods, nanocatalysis developments have the potential to obtain low sulfur gasoline and diesels, and high American Petroleum Institute (API) degree fuels.

“One of our main research areas is focused on how to

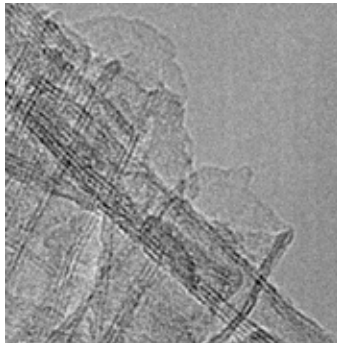


Fig. 1: Metal oxide Nanotubes used in the development of new catalysts materials

reduce the density of oil found in Mexico. Oil has different API and Mexican crude oil is characteristically heavy (8-12 API). Starting with heavy hydrocarbons, and based on new materials, we will design and develop a brand new compound, to reduce the API of the oil, enabling less expensive processing and transport,” explains Garibay.

“Having a fully equipped FEI Titan was critically important to obtain three important IMP patents. For us, the challenge is to patent new materials not owned by the United States or Japan who

have a large number of patents on the topic,” says Garibay.

“To obtain patents on advanced materials, IMP scientists must go down to the nanoscale level to show the differences. The Titan allows us to prove that the atomic structure is completely different. We use several types of microscopes for characterization, but Titan is the key player. To characterize the catalyst materials, our Titan defined the atomic-level structure arrangement. If you want to know what is inside the particles and the atomic distribution, go to the Titan,” Garibay commented.

FEI supplied more than equipment to help the IMP ultra-high resolution lab become operational. “FEI supported us all along by providing us with training to learn the equipment. In a second training session, they addressed special questions after we used the equipment for awhile. Finally, we continue to work with FEI when questions arise along the way. We’ve had very good response time for our applications,” says Garibay. FEI also helped to eliminate the effects of the building’s vibration by assisting with the design of a special platform for the Titan.

The Result

“With FEI equipment, we have been able to keep the patents for the institute,” says Garibay. Patents are vital for commercializing IMP’s research into new materials. Advanced materials samples must be escalated to industrial production to be sold commercially to the oil industry. “The results are very good compared with what we had before using outside equipment. The results quality is very high, thus it allows IMP to be positioned among the world leaders. Each branch of the Institute contributes to this leadership,” says Garibay. “We also have the advantage of having all the lab equipment in one location. In the United States, for example, universities may have equipment spread across several campuses, ours is just down the hallway. If we want to be at the cutting edge, we must move this way. We want to be the reference source for all universities and institutions in Mexico,” concluded Garibay.

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