The ACS Student Member Magazine

Mostafa El-Sayed's Nano Scale Fight Against Cancer

Eminent Scientist Mostafa El-Sayed to Present at the 254th ACS National Meeting in Washington DC
By Eric Stewart | August 17, 2017

Mostafa El-Sayed, Ph.D., an internationally recognized chemist and 2016 winner of ACS' highest honor, the Priestley Medal, will present the Eminent Scientist Lecture as part of the Undergraduate Program at the 254th ACS National Meeting & Exhibition (August 20–24, 2017 in Washington, DC). El-Sayed will share insights about his research groups' promising new approach for cancer treatment.

With a career that began over 60 years ago in Egypt, El-Sayed's research efforts today are focused in two unique areas: photo-thermal-based cancer therapy using targeted plasmonic nanoparticles and monitoring cellular processes using a combination of enhanced spectroscopic techniques, traditional biochemistry, and dark-field microscopy/spectroscopy.

Eminent Scientist Lecture & Luncheon

Undergraduate students can find tickets in their badges

"The Many Great Advantages of Gold Photo-Thermal Therapy of Cancer"
Mostafa El-Sayed, Ph.D., Georgia Institute of Technology
Noon–1:30, Monday, August 21, 2017

El-Sayed will share how properties change as materials are reduced to the nano scale, and how those changes make gold nano-rods an exciting new approach to killing cancer cells.

A new approach to an old problem

Traditional methods of treating cancer include a range of approaches, including radiation, chemotherapy, and surgery. According to El-Sayed, there is a critical weakness in all the standard approaches: cancer cells tend to respond by migrating to other parts of the body, using protein strings that propel the cells through the bloodstream. His research groups are trying to find a way to first immobilize the cancer cells' ability to migrate, and then kill them.

El-Sayed is overseeing three research groups — one in the United States and two in Egypt. The researchers in Cairo are currently conducting *in vivo* testing among a small set of dog and cat subjects. Preliminary results indicate the treatment is succeeding at not only killing the cancer cells, but also preventing their migration to other parts of the body. Currently El-Sayed's work is focusing on treating breast cancer cells, but the concept has the potential to address other types of cancer as well.

A long and rewarding career

El-Sayed's early career took him from his small village in the Nile Delta to Cairo's Ain Shams University, where he earned a B.Sc. degree. He was just getting started on a career in teaching when he learned of an opportunity for Egyptian students with backgrounds similar to his to apply to a Florida State University (FSU) graduate studies program. His acceptance to FSU was the start of a satisfying career in research that took him to Harvard, the California Institute of Technology, University of California-Los Angeles (UCLA), and, finally, the Georgia Institute of Technology.

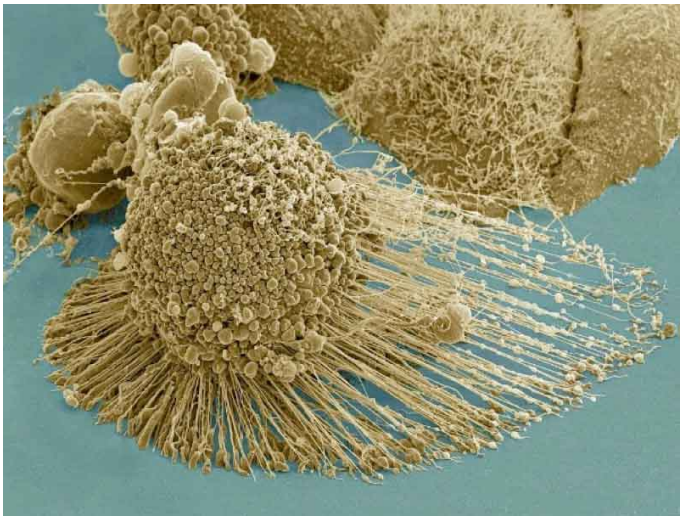
At UCLA in the 1960s, El-Sayed led a research group using molecular spectroscopy to investigate mechanisms and processes within molecules, gas-phase clusters, and other environments. His group gained international recognition when it experimentally verified a set of rules governing electronic relaxation in organic molecules — a line of inquiry that produced what have come to be known as the El-Sayed rules.

Almost 30 years later, in the early 1990s, El-Sayed began pursuing research in nanotechnology and was eventually invited by Georgia Tech to head its research in the emerging field. El-Sayed assembled a research group that began looking at semiconductor nanoparticles, and later moved its focus to metallic (mostly platinum, palladium, gold, and silver) nanoparticles.

Later in that decade, however, El-Sayed's wife Janice was diagnosed with breast cancer. "My wife suffered with cancer for five years, he recalls, and she endured radiation treatment followed by chemotherapy that seemed to work for a while, but eventually just didn't work anymore." As he helped her through the ordeal, El-Sayed began reading up on the current research on cancer and its treatment.

Finding a path to a solution

Unfortunately, El-Sayed's wife died in 2004. But he continued his work in nanotechnology, now with a special interest in its potential as a targeted delivery system of photo-thermal treatment of breast cancer. His research group at Georgia Tech explored the possibility of creating a solution with extremely small, gold nano-rods that could be injected near the cancerous tissue, exposed to near-IR light to raise its temperature just high enough to destroy the cancer cells.



Each cancer cell has "legs" that help it migrate. E-Sayed's method of using heated gold nano-rods melts these legs, stopping cancer cells from migrating to other parts of the patient's body where they could be more harmful or even deadly.

One of the researchers' major scientific breakthroughs came in 2014, when they found that gold nano-rods of a specific size — approximately 45 x 20 nm — converted light into heat. "What we've found," says El-Sayed, "is that by raising the temperature to about 45°C, the cancer cells completely melt, and the incidence of cells surviving to migrate elsewhere is eliminated."

A second break occurred after El-Sayed had given a talk in Egypt about his group's research. Following the presentation, he was asked by the Egyptian National Research Centre and Cairo University to direct their research teams. The groups soon began offering the experimental photo-thermal therapy for pets that had been diagnosed with cancer.

The group now has three years of data from approximately 40 cats and dogs under treatment, and the results are very promising. Not only did the treatment kill the cancerous cells in the animals, but there have been far fewer incidences of cancers spreading in the animals compared with those that would be seen using standard treatment approaches. "In fact," El-Sayed says, "now, every morning people are standing in line at our lab with their cats or dogs that need to be treated."

El-Sayed notes that the technique is still in its initial testing, and in the United States, it will take more time to do additional testing. "But if we continue seeing the successes," he says, "we hope to begin testing our technique with human subjects sometime in the near future."

El-Sayed's impressive C.V.

Mostafa El-Sayed has several roles today, in addition to his leadership of three research groups — including a position as Regents' Professor and the Julius Brown Chair at the Georgia Institute of Technology and director of the institution's Laser Dynamics Laboratory. During the course of his career, he also served for 24 years as editor-in-chief of ACS' *Journal of Physical Chemistry*, where he oversaw the journal's climb in popularity to the point that it eventually evolved into two journals.

El-Sayed has received a long and impressive list of awards and recognitions, including the US National Medal of Science in Chemistry from the President of the United States in 2008 and the Medal of the Egyptian Republic of the First Class from the President of Egypt in the following year. He was nominated

by the U.S. President to the US National Medal of Science Selection Committee in 2014, served a two-year term, and has been reappointed for a second term.

He was also the 2016 recipient of ACS' Priestley Medal. In accepting the medal, El-Sayed modestly observed, "I believe that everyone gets a few good breaks in his or her life. The lucky ones are those who recognize them and change their lives accordingly."

Taking the macro view

Because of his late wife's experience with cancer, El-Sayed has a genuine passion for his work. "I hope that one day, people will make use of the technique my teams have been working on, and deaths from cancer will be reduced."

El-Sayed is a humble man, and acknowledges the series of lucky breaks that have helped him along on his long career. He also acknowledges that he has benefited from a lifelong curiosity and interest in new technologies and scientific concepts. "My advice to young people entering the chemistry field is to continue to learn about emerging research by reading publications and attending meetings," he says. "I hope that my presentation will be inspiring to young chemists as they're finding their own paths."

About the Author

Eric Stewart is a freelance writer and editor living in Arlington, Virginia.