ScienceWatch Home
Inside This Month...
Interviews

Featured Interviews
Author Commentaries
Institutional Interviews
Journal Interviews
Podcasts

Analyses

Featured Analyses
What's Hot In...
Special Topics

Data & Rankings

Sci-Bytes
Fast Breaking Papers
New Hot Papers
Emerging Research Fronts
Fast Moving Fronts
Corporate Research Fronts
Research Front Maps
Current Classics
Top Topics
Rising Stars
New Entrants
Country Profiles

About Science Watch

Methodology
Archives
Contact Us
RSS Feeds

FAST BREAKING PAPERS - 2009

June 2009

PDF

Wei Chen talks with *ScienceWatch.com* and answers a few questions about this month's Fast Breaking Paper in the field of Materials Science.

Article Title: Nanoparticle fluorescence based technology for biological applications
Authors: Chen, W
Journal: J NANOSCI NANOTECHNOL
Volume: 8
Issue: 3
Page: 1019-1051
Year: MAR 2008
* Univ Texas Arlington, Dept Phys, POB 19059, Arlington, TX 76019 USA.
* Univ Texas Arlington, Dept Phys, Arlington, TX 76019 USA.

SW: Why do you think your paper is highly cited?

This is a review article that summarized the research projects undertaken in my lab. It also introduced several related activities from among other groups. Several of our projects have been of interest to public readers. This paper contains much new information and I think this may have been why it has been highly cited.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

It describes new concepts and methodologies, particularly the concept of nanoparticle self-lighting photodynamic therapy for cancer treatment, the concept of combining photodynamic therapy and radiation therapy for deep cancer treatment, and the applications of nanoparticle photosensitizers for cancer treatment. These are brand new approaches in nanotechnology.

SW: Would you summarize the significance of your paper in layman's terms?

In this paper, we introduced several new developments in nanotechnology for biological applications. For example, nanoparticle-based photodynamic therapy is one of the most exciting approaches described in this article. The goal is to find an efficient cancer therapy by developing X-ray luminescence nanoparticles as a light source for photodynamic therapy.

Photodynamic therapy has been designated as a "promising new modality in the treatment of cancer" since the early 1980s. Light must be delivered in order to activate photodynamic therapy. Most drugs used for photodynamic therapy require ultraviolet or blue light for activation. Unfortunately, ultraviolet and blue light have minimal penetration into tissue and their application for deep cancer therapy is a problem.

To solve this problem and also to enhance the treatment for deep cancers, we proposed a new photodynamic therapy system in which the light is generated by X-ray

luminescence nanoparticles. The X-ray luminescence nanoparticles and afterglow nanoparticles are attached to photoactive drugs and, when the nanoparticle-drug systems are targeted to the tumor and are stimulated by an X-ray during radiotherapy, these nanoparticles will generate light (energy) which activate the drugs for photodynamic therapy.

In this case, no direct light delivery to the tumor is necessary and very low doses of radiation are needed. In this modality, the radiation and photodynamic therapies are combined and occur simultaneously, so that the tumor destruction will be more efficient. More importantly, it can be used for deep tumor treatment, as X-rays can penetrate deeply into the tissue. Once demonstrated, this will provide a simple but more efficient modality for breast cancer treatment.

"...the slowing economy in the USA has really affected the funding of many new scientific projects."

SW: How did you become involved in this research, and were there any problems along the way?

I have been working on nanotechnologies for the past 15 years. My original work concentrated on trying to use quantum dots for *in vivo* imaging, with a concentration on the challenge of light penetration. I also have experience with the design and synthesis scintillation measurement for nanoparticles.

I knew light delivery was also a challenging issue for photodynamic therapy, just like *in vivo* optical imaging. I then arrived at the idea to combine photodynamic therapy with radiation therapy through scintillation nanoparticles for deep cancer treatment.

Photodynamic therapy is not new, nor is radiation therapy, but the combination of both through scintillation nanoparticles is new and potentially important for deep cancer treatment. I introduced the concept in a paper published in the *Journal of Nanoscience and Nanotechnology* in 2006. (Wei Chen and Jun Zhang, "Using Nanoparticles to Enable Simultaneous Radiation and Photodynamic Therapies for Cancer Treatment," *Journal of Nanoscience and Nanotechnology* 6[4]: 1159-66, April, 2006).

Initial results of the studies have been promising. But before "nanoparticle self-lighting photodynamic therapy" becomes a clinical reality, researchers must overcome two main challenges: 1) they need to develop a class of water-soluble scintillation nanoparticles with very high quantum efficiencies of X-ray luminescence, and 2) they need to improve the targeting capabilities of the nanoparticle-photosensitizer compound—but this is a challenge for all drug-based cancer treatments.

Most recently, we've used afterglow nanoparticles for photodynamic therapy activation. This is a good solution for improving efficiency since afterglow nanoparticles will maintain their luminescence for a certain period of time after activation. In this case, the radiation dose will be reduced exponentially. This new concept is also introduced in a recent publication: Chen, W. "Nanoparticle self-Lighting photodynamic therapy for cancer treatment," *J. Biomed. Nanotechnol* 4[4]: 369-76, 2008.

SW: Where do you see your research leading in the future?

This concept is getting more popular and has become intriguing to many investigators. I think this will become quite a hot area during the next decade and that products for practical applications will, sooner or later, be realized.

One of our recent review papers has appeared on the *ScienceDirect* "25 Hottest Articles" list for October—December, 2008: (Juzenas, P., *et al.*,"Quantum dots and nanoparticles for photodynamic and radiation therapies of cancer," *Advanced Drug Delivery Reviews* [60]15: 1600-14, December 2008).

By the way, many cancer patients and/or their families have contacted me directly and enquired as to the timing for this new modality to become available for patient treatment. I have sensed this urgent need and that is the key motivation for my research.

SW: Do you foresee any social or political implications for your research?

Although there are no obvious political implications for my research, the slowing economy in the USA has really affected the funding of many new scientific projects.

Wei Chen, Ph.D.
Assistant Professor
Department of Physics
The University of Texas at Arlington
Arlington, TX, USA

KEYWORDS: RESONANCE ENERGY-TRANSFER; RESPIRATORY SYNCYTIAL VIRUS; SEMICONDUCTOR

QUANTUM DOTS; UP-CONVERSION LUMINESCENCE; PHOTODYNAMIC THERAPY; MOLECULAR BEACONS; IN-VIVO; PHOTOPHYSICAL PROPERTIES; COLLOIDAL NANOPARTICLES; POTENTIAL APPLICATIONS.

PDF

back to top