

17 June 2010

This supplement has been prepared to present scientific and technical news items that may be of more interest to technical personnel at RDT&E activities and the labs, or the medics rather than the broader readership of the basic CB Daily. Due to the nature of the material, the articles, if available online, are usually only available through subscription services thus making specific links generally unavailable. Thus, usually only the bibliographic citation is available for use by an activity's technical library.

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Chem-Bio News – S&T Edition

1. COMPARATIVE STUDY OF OXIME-INDUCED REACTIVATION OF ERYTHROCYTE AND MUSCLE AChE FROM DIFFERENT ANIMAL SPECIES FOLLOWING INHIBITION BY SARIN OR PARAOXON: *"Hence, these data provide further support of the assumption that erythrocyte AChE is an adequate surrogate of muscle (synaptic) AChE and admonish that major species differences have to be considered for the design and evaluation of therapeutic animal models."*

2. EXPERIMENTAL TREATMENT PROTECTS MONKEYS FROM LETHAL EBOLA VIRUS POST-EXPOSURE: *"Scientists using tiny particles of genetic material to interfere in the replication process of the deadly Ebola virus have successfully prevented monkeys exposed to that virus from dying of hemorrhagic fever. The proof-of-concept study, published in this week's issue of The Lancet, suggests that such protection also should be possible in humans."*

3. NANOTECH YIELDS MAJOR ADVANCE IN HEAT TRANSFER, COOLING TECHNOLOGIES: *"These coatings can remove heat four times faster than the same materials before they are coated, using inexpensive materials and application procedures."*

4. ARTIFICIAL ANTIBODIES MADE FROM PLASTIC SHOWN TO WORK IN LIVING ANIMALS: *"A U.S.-Japanese research team has now developed methods for synthesizing protein-sized polymer particles with a binding affinity and selectivity comparable to those of natural antibodies by combining molecular imprinting nanoparticle synthesis with a functional monomer optimization strategy. In effect, they have created a plastic antibody, an artificial version of the real thing. They have also demonstrated that it works in the bloodstream of a living animal."*

5. CARBON NANOTUBE-POLYMER BASED NANOCOMPOSITE AS ELECTRODE MATERIAL FOR THE DETECTION OF PARAOXON: *"Due to high porosity of polymer and high electrical conductivity of CNT, a detection level of 3 nM paraoxon could be achieved."*

6. MEASURING THE EFFECT OF COMMUTING ON THE PERFORMANCE OF THE BAYESIAN AEROSOL RELEASE DETECTOR: *"We found that a simplified approach to accounting for commuting in detection-simplified to maintain tractability of inference-nearly*

fully restored both detection and characterization performance of BARD detector."

7. MESOPOROUS MANGANESE OXIDE NANOBELTS FOR DECONTAMINATION OF SARIN, SULPHUR MUSTARD AND CHLORO ETHYL ETHYL SULPHIDE:

"Decontamination products formed via hydrolysis were non-toxic methyl phosphonic acid, thiodiglycol and hydroxyl ethyl ethyl sulphide."

CB Daily Report

Chem-Bio News

COMPARATIVE STUDY OF OXIME-INDUCED REACTIVATION OF ERYTHROCYTE AND MUSCLE AChE FROM DIFFERENT ANIMAL SPECIES FOLLOWING INHIBITION BY SARIN OR PARAOXON

Biotech Week
June 23, 2010

"A recently introduced dynamically working in vitro model with real-time determination of membrane-bound AChE activity was shown to be a very versatile and promising model to investigate oxime-induced reactivation kinetics of OP-inhibited enzyme."

"In this assay, human AChE from erythrocytes or muscle tissue was immobilized on a particle filter. This bioreactor was continuously perfused with substrate and chromogen and AChE activity was analyzed on-line in a flow-through detector. The model has been successfully adopted to Rhesus monkey, swine and guinea pig erythrocytes and intercostal muscle AChE. In addition, the basic kinetic constants of inhibition, aging, spontaneous- and oxime-induced-reactivation of erythrocyte AChE from these species were determined with a standard static model. The major findings were, in part substantial species differences in the inhibition (sarin, paraoxon) and reactivation kinetics (obidoxime, HI 6) of erythrocyte AChE, but comparable kinetics of inhibition and reactivation between erythrocyte and muscle AChE."

"Hence, these data provide further support of the assumption that erythrocyte AChE is an adequate surrogate of muscle (synaptic) AChE and admonish that major species differences have to be considered for the design and evaluation of therapeutic animal models."

The full article can be found at: (N.M. Herkert, et. al., "Comparative study of oxime-induced reactivation of erythrocyte and muscle AChE from different animal species following inhibition by sarin or paraoxon". Toxicology Letters, 2010; 194(3):94-101). Link not available.

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EXPERIMENTAL TREATMENT PROTECTS MONKEYS FROM LETHAL EBOLA VIRUS POST-EXPOSURE

“Scientists using tiny particles of genetic material to interfere in the replication process of the deadly Ebola virus have successfully prevented monkeys exposed to that virus from dying of hemorrhagic fever. The proof-of-concept study, published in this week's issue of *The Lancet*, suggests that such protection also should be possible in humans.

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“Using particles called small interfering RNAs (siRNAs), the authors targeted a protein (called the L protein) that is essential for Ebola virus replication. RNA inhibitors, as they are commonly called, are based on a natural gene silencing mechanism used by all cells, and RNAi therapeutics rely on a delivery technology to be effective.

Lipid nanoparticles (LNPs) are the most widely used siRNA delivery approaches. In this study, the research team used a proprietary technology called SNALP, or stable nucleic acid-lipid particles, to deliver the therapeutics to disease sites in animal models infected with the Zaire strain of Ebola virus (ZEBOV).

A group of three rhesus macaques was given anti-ZEBOV siRNAs intravenously, 30 minutes after exposure to the virus, and again on days 1, 3, and 5. A second group of four macaques was given the treatment after 30 minutes, and on days 1, 2, 3, 4, 5, and 6, after challenge with ZEBOV.

Two of the three animals in the first group (which received four post-exposure treatments) were protected from lethal ZEBOV infection and survived. All four of the monkeys given seven post-exposure treatments were protected. The treatment regimen in the second study was well tolerated, with minor changes in liver enzymes that might have been related to viral infection.”

Link not available.

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NANOTECH YIELDS MAJOR ADVANCE IN HEAT TRANSFER, COOLING TECHNOLOGIES

Nanotechwire.com

June 09, 2010

“Researchers at Oregon State University and the Pacific Northwest National Laboratory have discovered a new way to apply nanostructure coatings to make heat transfer far more efficient, with important potential applications to high tech devices as well as the conventional heating and cooling industry.

These coatings can remove heat four times faster than the same materials before they are coated, using inexpensive materials and application procedures.”

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“For the configurations we investigated, this approach achieves heat transfer approaching theoretical maximums,” said Terry Hendricks, the project leader from the Pacific Northwest National Laboratory. “This is quite significant.”

The improvement in heat transfer achieved by modifying surfaces at the nanoscale has possible applications in both micro- and macro-scale industrial systems, researchers said. The coatings produced a “heat transfer coefficient” 10 times higher than uncoated surfaces.”

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“The research has been supported by the Army Research Laboratory. Further studies are being continued to develop broader commercial applications, researchers said.”

The full article can be found at: <http://www.nanotechwire.com/news.asp?nid=10005>

ANALYST NOTE: While the article focuses on possible uses in electronic and mechanical devices, there may also be an application with IPE.

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ARTIFICIAL ANTIBODIES MADE FROM PLASTIC SHOWN TO WORK IN LIVING ANIMALS

By Michael Berger
Nanowerk.com
June 11, 2010

“A U.S.-Japanese research team has now developed methods for synthesizing protein-sized polymer particles with a binding affinity and selectivity comparable to those of natural antibodies by combining molecular imprinting nanoparticle synthesis with a functional monomer optimization strategy.

In effect, they have created a plastic antibody, an artificial version of the real thing. They have also demonstrated that it works in the bloodstream of a living animal.

As a result, we can now consider synthetic polymer nanoparticles, prepared by an abiotic process in the chemical laboratory, as alternatives to biological macromolecules. Applications could include antidotes for toxins, protein purification and therapies that currently use antibodies.”

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“To fabricate their plastic antibodies, the team uses an approach called molecular imprinting, a process similar to leaving a footprint in wet concrete. For these particular experiments, they chose melittin – the principal active component of bee venom and a well-studied biotoxin – as the target and imprint molecule. They mixed it with a monomer solution and

then started a chemical reaction that links these building blocks into long chains, and makes them solidify. When the plastic particles hardened, the researchers leached the melittin out. That left the polymer nanoparticles with tiny melittin-shaped craters, i.e. melittin-imprinted polymer nanoparticles.

The researchers tested the efficacy of their plastic antibodies in vivo on mice. Mice were injected intravenously with a high dose of melittin and then intravenously with the synthesized polymer antibodies. A control group that did not receive the antibody injection showed a 100% mortality rate. The group that received the plastic antibodies showed a significantly reduced mortality rate as well as a significant reduction in peritoneal inflammation caused by melittin. The melittin - plastic antibody complexes were then cleared from the blood by the mononuclear phagocytic system in the liver."

The full article can be found at: <http://www.nanowerk.com/spotlight/spotid=16668.php>

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CARBON NANOTUBE-POLYMER BASED NANOCOMPOSITE AS ELECTRODE MATERIAL FOR THE DETECTION OF PARAOXON

Science Letter

June 15, 2010

Biosensor based on the inhibition of enzymes has been used for the detection of organophosphorous compounds wherein amperometric method has been employed. Carbon nanotubes (CNT) has been grown over YNi₃ alloy hydrides and purified for further use."

"The high surface area and the acidic sites created during the purification of CNT with oxidizing acids have been exploited for the adsorption and entrapment of the enzyme acetylcholine esterase. In the present work, conducting polymer polypyrrole has been uniformly coated over the CNT surface using chemical oxidative technique. The nanocomposite was characterized by scanning electron microscopy (SEM) and High resolution transmission electron microscopy (HRTEM). In the present report high catalytic activity of CNT towards the electrooxidation of thiocholine has been utilized for the detection of organophosphorous compound paraoxon. Developed biosensor uses the principal of acetylcholinesterase inhibition by nerve agent and hence reduction in oxidation current of thiocholine for the detection of paraoxon. Synthesized PPY-MWNT nanocomposite has been used for the electrode preparation over GC electrode. Due to high porosity of polymer and high electrical conductivity of CNT, a detection level of 3 nM paraoxon could be achieved."

The full article can be found at: (N. Jha, et. al., "Carbon nanotube-polymer based nanocomposite as electrode material for the detection of paraoxon". Journal of Nanoscience and Nanotechnology, 2010; 10(4): 2798-802). Link not available.

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MEASURING THE EFFECT OF COMMUTING ON THE PERFORMANCE OF THE BAYESIAN AEROSOL RELEASE DETECTOR

Computer Technology Journal
June 17, 2010

"The Bayesian Aerosol Release Detector (BARD) is a system for detecting releases of aerosolized anthrax and characterizing them in terms of location, time and quantity."

"Modelling a population's exposure to aerosolized anthrax poses a number of challenges. A major difficulty is to accurately estimate the exposure level-the number of inhaled anthrax spores-of each individual in the exposed region. Partly, this difficulty stems from the lack of fine-grained data about the population under surveillance. To cope with this challenge, nearly all anthrax biosurveillance systems, including BARD, ignore the mobility of the population and assume that exposure to anthrax would occur at one's home administrative unit-an assumption that limits the fidelity of the model. We employed commuting data provided by the U. S. Census Bureau to parameterize a commuting model. Then, we developed methods for integrating commuting into BARD's simulation and detection algorithms and conducted two studies to measure the effect. The first study (simulation study) was designed to assess how BARD's detection and characterization performance are impacted by incorporation of commuting in BARD's outbreak-simulation algorithm. The second study (detection study) was designed to measure the effect of incorporating commuting in BARD's outbreak-detection algorithm. We found that failing to account for commuting in detection (when commuting is present in simulation) leads to a deterioration in BARD's detection and characterization performance that is both statistically and practically significant. We found that a simplified approach to accounting for commuting in detection-simplified to maintain tractability of inference-nearly fully restored both detection and characterization performance of BARD detector. We conclude that it is important to account for commuting (and mobility in general) in BARD's simulation algorithm. Further, the proposed method for incorporating commuting in BARD's detection algorithm can successfully perform the necessary correction in the detection algorithm, while preserving BARD's practicality."

The full article can be found at: (A. Cami, et. al., "Measuring the effect of commuting on the performance of the Bayesian Aerosol Release Detector". BMC Medical Informatics and Decision Making, 2009;9(Suppl. 1):S7). Link not available.

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MESOPOROUS MANGANESE OXIDE NANOBELTS FOR DECONTAMINATION OF SARIN, SULPHUR MUSTARD AND CHLORO ETHYL ETHYL SULPHIDE

Science Letter
June 15, 2010

"Mesoporous manganese oxide nanobelts were synthesized by hydrothermal-ion exchange method and characterized by transmission electron microscopy, scanning electron microscopy, X-ray diffraction, N-2-BET, thermogravimetry and FT-IR techniques."

"Decontamination reactions of sarin [sic] (GB), sulphur mustard (HD) and chloro ethyl ethyl sulphide (CEES) were studied on obtained mesoporous material by using gas chromatography (GC) and gas chromatography coupled with mass spectrometry (GC-MS) techniques. Decontamination products formed via hydrolysis were non-toxic methyl phosphonic acid, thiodiglycol and hydroxyl ethyl ethyl sulphide."

"Decontamination reactions exhibited pseudo first order behavior and the values of rate constant and half life were found to be 0.43 h⁻¹ and 1.6 h for GB, 0.01 h⁻¹ and 69.32 h for HD, and 0.02 h⁻¹ and 34.66 h for CEES, respectively."

The full article can be found at: (T.H. Mahato, et. al., "Mesoporous manganese oxide nanobelts for decontamination of sarin, sulphur mustard and chloro ethyl ethyl sulphide". Microporous and Mesoporous Materials, 2010; 132(1-2):15-21). Link not available.

ANALYST NOTE: Further information can be obtained from: G.K. Prasad, Def Research & Development Estab, PD Division, Jhansi Rd., Gwalior 474002, MP, India.

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