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CHEMICAL EFFECTS

Urinary biomarkers of nucleic acid oxidation and methylation in workers exposed to low concentrations of benzene

2020-06-17

The study aims to investigate the influence of exposure to low concentrations of benzene on urinary biomarkers of nucleic acid oxidative damage and methylation. Benzene exposure was characterized for 93 coke production workers by measuring both airborne benzene and S-phenylmercapturic acid (SPMA) and unmodified benzene (U-B) in urine samples, collected at the end of the shift (ES) and at the next morning before shift (next BS). In the same urinary samples, biomarkers of oxidative damage and nucleic acid were determined. Urinary concentrations of cotinine and creatinine were also determined to evaluate the smoking effect and to normalize urinary concentrations of analytes, respectively. The biomarkers of benzene internal dose, of oxidative damage (8-hydroxy-7,8-dihydroguanine, 8-hydroxy-7,8-dihydroguanosine and 8-hydroxy-7,8-2'-deoxyguanosine) and some of the biomarkers of nucleic acid methylation (5-Methyl-Cytosine, 1-Methyl-Guanine and 7-Methyl-Guanine) were higher in the ES than the next BS samples. Positive associations between ES 5-Methyl-Cytosine and both SPMA and U-B were found. In conclusion, occupational exposure to low levels of benzene seems to be related to urinary ES 5-Methyl-Cytosine that could be a possible biomarker to evaluate the changes of the nucleic acid methylation status.

Authors: Piero Lovreglio, Angela Stufano, Roberta Andreoli, Cesare Tomasi, Paola Cagnazzi, Anna Barbieri, Leonardo Soleo, Giuseppe De Palma
Full Source: Toxicology Letters. 2020 Jun 17;S0378-4274(20)30283-6.
doi: 10.1016/j.toxlet.2020.06.010. Online ahead of print.

Metal oxide nanoparticle-decorated few layer graphene nanoflake chemoresistors for the detection of aromatic volatile organic compounds

2020-06-17

Benzene, toluene, and xylene, commonly known as BTX, are hazardous aromatic organic vapors with high toxicity towards living organisms. Many techniques are being developed to provide the community with portable, cost effective, and high performance BTX sensing devices in order to effectively monitor the quality of air. In this paper, we study the effect of decorating graphene with tin oxide (SnO_2) or tungsten oxide

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(WO_3) nanoparticles on its performance as a chemoresistive material for detecting BTX vapors. Transmission electron microscopy and environmental scanning electron microscopy are used as morphological characterization techniques. SnO_2 -decorated graphene displayed high sensitivity towards benzene, toluene, and xylene with the lowest tested concentrations of 2 ppm, 1.5 ppm, and 0.2 ppm, respectively. In addition, we found that, by employing these nanomaterials, the observed response could provide a unique double signal confirmation to identify the presence of benzene vapors for monitoring occupational exposure in the textiles, painting, and adhesives industries or in fuel stations.

Authors: Syrine Behi, Nadra Bohli, Juan Casanova-Cháfer, Eduard Llobet, Adnane Abdelghani

Full Source: Sensors (Basel, Switzerland). 2020 Jun 17;20(12):E3413.
doi: 10.3390/s20123413.

ENVIRONMENTAL RESEARCH

Determination of Neonicotinoids and Butenolide residues in Avian and Insect pollinators and their ambient environment in western Canada

2020-05-26

To examine the spatial, and temporal variation and potential sources of pesticide concentrations, primarily neonicotinoid insecticides, in hummingbirds in western Canada, we sampled their cloacal fluid from sites in British Columbia and Saskatchewan, Canada in 2017-2018. At a sub-sample of those sites, we also measured pesticides in honey bee (*Apis mellifera*) nectar, water, and sediment. We collected cloacal fluid from 5 species of hummingbirds (n = 26 sites) in British Columbia (BC) and Saskatchewan, Canada, and nectar from honey bee hives (n = 4 sites), water and sediment (n = 18 sites) in the Fraser Valley, BC. Among those, multiple types of samples were collected at 6 sites. We report the first measurement of flupyradifurone, a relatively new butenolide insecticide, in wildlife which was detected at 4.58 ng/mL in hummingbird cloacal fluid and 2.18 ng/g in honey bee nectar. We also detected three other neonicotinoids (imidacloprid, clothianidin, acetamiprid) and one metabolite desnitro-imidacloprid, and MGK264, a pesticide synergist, in our samples. Among 49 samples of cloacal fluid from rufous (*Selasphorus rufus*), Anna's (*Calypte anna*), calliope (*Selasphorus calliope*) black-chinned (*Archilocus alexandri*) and ruby-throated hummingbirds (*Archilocus colubris*), 26.5% (n = 13) contained neonicotinoids. Maximum pesticide concentrations in

We also detected three other neonicotinoids (imidacloprid, clothianidin, acetamiprid) and one metabolite desnitro-imidacloprid, and MGK264, a pesticide synergist, in our samples.

In the same urinary samples, biomarkers of oxidative damage and nucleic acid were determined.

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hummingbirds, water and sediment were found in samples collected in the Fraser Valley, BC within 0.5 km of conventionally sprayed blueberry fields (CSBF) but highest levels in honey bee nectar were detected at a site 1.5 km from a CSBF. Imidacloprid in honey bee nectar at one site exceeded concentrations (>1 ng/g) that can sublethally affect worker bee foraging efficiency. In water, imidacloprid concentrations at another site exceeded Canadian guidelines (230 ng/mL) for the protection of aquatic invertebrates.

Authors: Christine A Bishop, Million B Woundneh, France Maisonneuve, Julia Common, John E Elliott, Alison J Moran

Full Source: The Science of the Total Environment. 2020 May 26;737:139386. doi: 10.1016/j.scitotenv.2020.139386. Online ahead of print.

A radon chamber specifically designed for environmentally relevant exposures of small animals

2020-05-06

In order to facilitate direct testing of the biological effects of radon, we designed and constructed a 3.1 m³ radon chamber specifically for radon exposures to small animals. The chamber is designed to operate as a sealed enclosure with a controlled atmosphere containing a known concentration of radon and its radioactive decay products. Sensors for air flow rate, temperature, humidity, HEPA filter and differential pressure ensure an optimal environment for exposure subjects. The radon gas is supplied to the chamber from a generator containing Radium-226 in a dilute acid solution. Air containing radon can be pumped continuously using a constant flow rate to maintain a steady state supply. The source flow rate was partitioned to achieve a chamber concentration at 200 Bq/m³ ($R^2 = 0.9341$) or 1000 Bq/m³ ($R^2 = 0.9715$). Small particles are injected into the re-circulating air stream via a particle generator to provide condensation nuclei for attachment of radon decay products as they form in the chamber atmosphere. Particles measured at 0.3 μm, 0.5 μm and 5.0 μm averaged concentrations $5.7 \pm 0.6 \times 10^7/\text{m}^3$, $2.5 \pm 0.7 \times 10^7/\text{m}^3$ and $2.3 \pm 2.4 \times 10^3/\text{m}^3$, respectively. A desired Equilibrium Factor can easily be achieved by varying the air circulation rate through the chamber. The Equilibrium Factor ranged from 0.4 to 0.8 at 200 Bq/m³ and 0.5 to 0.6 at 1000 Bq/m³. The chamber was designed to conduct short term exposures to assess the acute cellular changes induced by radon exposure. To our knowledge, this is currently the only radon chamber designed specifically to investigate environmentally relevant

The chamber is designed to operate as a sealed enclosure with a controlled atmosphere containing a known concentration of radon and its radioactive decay products.

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exposure time and doses of radon gas and decay products in small animal models.

Authors: Stephanie Puukila, Peter Haigh, Andrew Johnston, Douglas R Boreham, Antony M Hooker, Dani-Louise Dixon

Full Source: Journal of environmental radioactivity. 2020 Sep;220-221:106295. doi: 10.1016/j.jenvrad.2020.106295. Epub 2020 May 6.

Developing a low-cost passive method for long-term average levels of light-absorbing carbon air pollution in polluted indoor environments

2020-06-17

We propose a low-cost passive method for monitoring long-term average levels of light-absorbing carbon air pollution in polluted indoor environments. Building on prior work, the method here estimates the change in reflectance of a passively exposed surface through analysis of digital images. To determine reproducibility and limits of detection, we tested low-cost passive samplers with exposure to kerosene smoke in the laboratory and to environmental pollution in 20 indoor locations. Preliminary results suggest robust reproducibility ($r = 0.99$) and limits of detection appropriate for longer-term (~1-3 months) monitoring in households that use solid fuels. The results here suggest high precision; further testing involving «gold standard» measurements is needed to investigate accuracy.

Authors: Lara P Clark, V Sreekanth, Bukin Bekbulant, Michael Baum, Songlin Yang, Pao Baylon, Timothy R Gould, Timothy V Larson, Edmund Y W Seto, Chris D Space, Julian D Marshall

Full Source: Sensors (Basel, Switzerland). 2020 Jun 17;20(12):E3417. doi: 10.3390/s20123417.

To determine reproducibility and limits of detection, we tested low-cost passive samplers with exposure to kerosene smoke in the laboratory and to environmental pollution in 20 indoor locations.

PHARMACEUTICAL/TOXICOLOGY

Synthesis of quenchbodies for one-pot detection of stimulant drug Methamphetamine

2020-06-11

The problem of illicit drug use and addiction is an escalating issue worldwide. As such, fast and precise detection methods are needed to help combat the problem. Herein, the synthesis method for an anti-methamphetamine Quenchbody (Q-body), a promising sensor for use in simple and convenient assays, has been described. The fluorescence intensity of the Q-body generated by two-site labeling of Escherichia

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coli produced anti-methamphetamine antigen-binding fragment (Fab) with TAMRA-C2-maleimide dyes increased 5.1-fold over background in the presence of a hydroxyl methamphetamine derivative, 3-[(2S)-2-(methylamino)propyl]phenol. This derivative has the closest structure to methamphetamine of the chemicals available for use in a laboratory. Our results indicate the potential use of this Q-body as a novel sensor for the on-site detection of methamphetamine, in such occasions as drug screening at workplace, suspicious substance identification, and monitoring patients during drug rehabilitation.

Authors: Hee-Jin Jeong, Jinhua Dong, Chang-Hun Yeom, Hiroshi Ueda
Full Source: Methods and protocols. 2020 Jun 11;3(2):E43. doi: 10.3390/mps3020043.

The association between metal exposure and semen quality in Chinese males: the mediating effect of Androgens

2020-01-22

As a crucial factor in male reproduction, androgens may represent an intermediate biological mechanism linking metal exposure with effects on semen quality. This study aimed to investigate the association between metal exposure and semen quality, and to assess the mediating role of seminal androgens between metal exposure and semen quality. We investigated the presence of 10 metals in semen and assessed their effect on semen quality in 1136 men recruited from a hospital in Shenzhen, China. Of these, 464 subjects were randomly selected for 4 androgens detection in semen. Cross-sectional associations between single/multiple metals, androgen levels and semen quality were explored by multivariable linear regressions. Mediation analysis was performed to detect the role of seminal androgens on the association between metal exposure and semen quality. Seminal selenium and iron were positively associated with both sperm concentration and total sperm count. Negative associations were observed between both manganese and zinc and sperm concentration, molybdenum and total sperm count, copper and sperm motility. Furthermore, we found significant dose-dependent relationships between both iron and selenium levels and dihydrotestosterone (DHT), arsenic levels and testosterone, as well as zinc and dehydroepiandrosterone. Mediation analysis indicated that higher seminal iron and selenium were associated with an increasing sperm concentration after controlling for DHT, with 10.32% and 12.89% of these associations were mediated by DHT, respectively. A similar mediation effect of DHT was observed in the associations between iron and selenium levels and total sperm count

We investigated the presence of 10 metals in semen and assessed their effect on semen quality in 1136 men recruited from a hospital in Shenzhen, China.

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[13.39% and 21.57% mediation, respectively]. Our findings suggested that the presence of selenium and iron in semen was beneficial to sperm concentration and total count. Seminal manganese, zinc, molybdenum and copper may be associated with reduced semen quality. The associations between seminal selenium and iron and sperm concentration and total count were partially explained by the concomitant variation of seminal DHT. Authors: Peiyi Liu, Guanxiang Yuan, Qi Zhou, Yu Liu, Xinpeng He, Humin Zhang, Yinsheng Guo, Ying Wen, Suli Huang, Yuebin Ke, Jinqian Chen
Full Source: Environmental Pollution (Barking, Essex: 1987). 2020 Sep;264:113975. doi: 10.1016/j.envpol.2020.113975. Epub 2020 Jan 22.

Per- and Polyfluoroalkyl substances in early pregnancy and risk for Preeclampsia: A case-control study in southern Sweden

2020-06-16

Preeclampsia is one of the most common causes of perinatal and maternal morbidity/mortality. One suggested environmental risk factor is exposure to endocrine-disrupting pollutants such as per- and polyfluoroalkyl substances (PFAS). The present case-control study in southern Sweden aims to investigate the hypothesized association between serum concentrations of PFAS in early pregnancy and the risk of developing preeclampsia. The study included 296 women diagnosed with preeclampsia (cases) and 580 healthy pregnant women (controls). Maternal serum samples were obtained from a biobank of samples collected in early pregnancy in connection with screening for infections. Serum concentrations of perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorononanoic acid (PFNA), and perfluorohexane sulfonate (PFHxS) were analyzed using liquid chromatography-tandem-mass-spectrometry (LC/MS/MS). Among primiparous women, there were no differences in PFAS concentrations in early pregnancy between the cases and the controls whereas among multipara women, the cases had significantly higher concentrations of PFNA (median concentrations were 0.44 and 0.38 ng/mL, $p = 0.04$). When individual PFAS were categorized into quartiles and adjustment for potential confounders was performed, the women in the highest quartiles had no significant increased risks of developing preeclampsia as compared with women in the lowest category. In conclusion, the present study provides limited support for the

One suggested environmental risk factor is exposure to endocrine-disrupting pollutants such as per- and polyfluoroalkyl substances (PFAS).

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hypothesized association between PFAS and preeclampsia in a population with relatively low exposure levels.

Authors: Lars Rylander, Christian H Lindh, Stefan R Hansson, Karin Broberg, Karin Källén

Full Source: *Toxics*. 2020 Jun 16;8(2):E43. doi: 10.3390/toxics8020043.

OCCUPATIONAL

Polymorphisms in XPC and XPD genes modulate DNA damage in pesticide-exposed agricultural workers of Punjab, north-west India

2020-06-19

The genetic susceptibility of individuals to the genotoxic effect of pesticides may be modulated by variations in genes involved in nucleotide excision repair (NER) pathway and therefore plays an important role in the evaluation of occupational risk. We aimed to evaluate the role of xeroderma pigmentosum complementation group C (XPC) Lys939Gln (A2920C, rs2228001), XPC Ala499Val (C2151T, rs2228000), xeroderma pigmentosum complementation group D (XPD) Asp312Asn (G23591A, rs1799793) and XPD Lys751Gln (A35931C, rs13181) in the modulation of DNA damage. A total of 450 subjects (225 pesticide-exposed agricultural workers and 225 age- and sex-matched controls) from Punjab, North-West India were recruited to study DNA damage by alkaline comet assay. Genotyping was carried out by PCR-RFLP using site-specific restriction enzymes. We found significant elevation in DNA damage parameters in pesticide-exposed agricultural workers as compared to the controls ($p < 0.01$). Association of comet tail length with XPC 939Gln/Gln (CC), XPD 312Asp/Asn (GA) and XPD 312Asn/Asn (AA) genotypes was observed. Frequency of cells showing DNA migration was significantly higher in exposed workers with variant XPC 939Gln/Gln (CC), XPD 312Asp/Asn (GA) and XPD 312Asn/Asn (AA) genotypes. Mean tail length was significantly increased in agricultural workers carrying XPD 312Asn/Asn (AA) genotype. Elevation in total comet DNA migration was also observed in exposed workers carrying variant XPC 939Lys/Gln (AC), XPC 939Gln/Gln (CC), XPC 499Val/Val (TT) and XPD 312Asn/Asn (AA) genotypes. Our results strongly indicate significant

We found significant elevation in DNA damage parameters in pesticide-exposed agricultural workers as compared to the controls ($p < 0.01$).

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positive association of variant XPC and XPD genotypes with higher pesticide-induced DNA damage in North-West Indian agricultural workers.

Authors: Karashdeep Kaur, Rupinder Kaur

Full Source: *Molecular Biology Reports*. 2020 Jun 19. doi: 10.1007/s11033-020-05600-6. Online ahead of print

Simulation of lead fume emissions in the workplace using computational fluid dynamics in the electronics industry

2020-06-16

Computational fluid dynamics (CFD) is a powerful method for predicting the release of pollutants in the workplace and has recently been used as a valuable tool by health authorities. The purpose of this study was to predict the distribution of lead fume in the workplace using computational fluid dynamics in the electronics manufacturing industry. A cross-sectional descriptive and analytical study was conducted in the Neyshabur electronics industry (2019). Individual exposure to lead fume was measured by the OSHA121 method. Simulation and prediction of lead fume emission in the workplace were done using computational fluid dynamics and by the ANSYS16 software. The mean of personal exposure to lead fumes was 0.04 ± 0.01 mg/m³. The software predicted the distribution of lead fumes in the respiratory zone of the worker to be in the range of 0.04 to 0.07 mg/m³, which is very close to the real values. By doubling the suction power of the topical ventilation used, workers' exposure to lead fumes was nearly halved and reached well below the recommended limit. The results showed that CFD is a useful tool for simulating individual contact with pollutants in a geometry. Also, given that the CFD shows the diffusion and distribution of pollutants in all points of a geometry, it is useful to indicate critical locations and conditions.

Authors: Somayeh Rahimi Moghadam, Mahmoud Mohammadyan, Amin Markani, Narges Khanjani, Mahdi Jalali

Full Source: *Environmental science and pollution research international*. 2020 Jun 16. doi: 10.1007/s11356-020-09566-7. Online ahead of print.

The purpose of this study was to predict the distribution of lead fume in the workplace using computational fluid dynamics in the electronics manufacturing industry.