Contribution ID: **51** Type: **Oral Presentation**

Effect of surface chemical heterogeneity of carbon textiles on their detoxification activity against CWA surrogate

Wednesday, May 22, 2024 9:40 AM (20 minutes)

Activated carbon textiles, owing to their physical form and developed porosity might have a potential to replace activated carbon layers in either gas masks or warfighters'garments. In order to increase their detoxification activity modification of surface chemistry is needed. It is well known that certain functional groups on the carbon surface might increase the catalytic activity [1] and even can provide photoactivity [2], leading to the oxidation of toxic compounds to less toxic species or their decomposition. This heteroatom catalytic activity can be also enhanced by an introduction of an additional active phases [3].

In this work porous carbon textile swatches were first oxidized using various treatments to modify their porosity and to create anchoring sites for an introduction of nitrogen and sulfu -containing functional groups It is interesting that a very strong level of oxidation led to a complete blocking of porosity while preserving a textile morphology and elasticity. NH3 and H2S treatments at 500 and 900 oC were applied to introduce surface groups. The low treatment temperature was expected to functionalize the carbon surface with N and S groups, respectively, and the high one - to dope the heteroatoms to the carbon rings, leading also to a decrease in their surface contents. The samples were characterized by adsorption of nitrogen, thermal analysis, potentiometric titration and XPS.

The decomposition of 2-chloroethyl ethyl sulfide (CEES, > 97% purity), mustard gas surrogate, was tested by dropping 5 μL 2-chloroethyl ethyl sulfide (CEES, > 97% purity), to the center of round-shaped textile samples (0.5-in diameter), which were already placed in hermetically closed glass vessels. The vials were closed and kept in direct light for various periods of time. Then, 2 mL of acetonitrile (> 99% purity) was introduced through the septum and the vial was shaken to extract the species remaining, and weakly bonded, to the surface. The extracts were analyzed by GC-MS.

The results indicated the various levels of catalytic activity which led to the decomposition of CEES to variety of compounds. The level of catalytic activity depended on the strength of CEES interactions with the carbon surface, affected by porosity and hydrophobicity level, on the specificity of groups, and on the absolute amounts of catalytic centers. Overall, the introduction of S and N to the carbon rings increased the speciation of oxidation products/decomposition efficiency, owing to the activation of molecular oxygen by these species

References:

1. M C.O. Ania and T. J. Bandosz. Surface Chemistry of Activated Carbons and its Characterization . In Activated Carbon Surfaces in Environmental Remediation, Bandosz, T. J. Ed. pp. 159-230. Elsevier, Oxford, 2006

2. T.J. Bandosz, C.O. Ania. Origin and Perspectives of the Photochemical Activity of Nanoporous Carbons. Advanced Science 2018, 5, 1800293.

3. D. A. Giannakoudakis , T J. Bandosz. Detoxification of Chemical Warfare Agents: From WWI to Multifunctional Nanocomposite Approaches, Springer 2018

Acknowledgements:

This work was supported by US DoD by grant #W911NF2310204

Primary authors: Dr FLORENT, Marc (CCNY); Dr PAULETTO, Paola S (CCNY); Prof. BANDOSZ, Teresa J

(CCNY/CUNY)

Presenter: Dr PAULETTO, Paola S (CCNY)

Session Classification: Wednesday

Track Classification: Oral Presentations