PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Dual-functional Mofs: Efficient Adsorption And Degradation Of A Nerve Agent Simulant And A Pesticide For Protective Applications

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Nerve agents are a class of highly toxic compounds that can be used as chemical warfare agents (CWAs). The recent use of these substances shows the relevance of the development of protective measures against these compounds. Currently, adsorption by cheap activated carbon provides protection against such toxic chemicals in personal protective equipment (PPE), such as gas masks and protective clothing. Whilst porous carbon can efficiently capture nerve agents, the threat agent spectrum is more broad, and carbon is not able to provide adequate protection against polar volatile compounds such as many toxic industrial chemicals (TICs). Another issue is that secondary release of toxic agents, as a result of the reversibility of adsorption, may pose a significant danger in handling exposed materials. Both aspects may be solved by the exploitation of metal-organic frameworks (MOFs). It has been shown that certain MOFs can adsorb toxic chemicals from air, while other MOFs have been shown to efficiently hydrolyse different types of nerve agents. In this contribution we showcase the development of a MOF that exhibits both of these favorable properties. The MOF was constructed based on a secondary building unit (SBU) that is capable of agent degradation, and a linker by which a MOF is created that has a high porosity and surface area in order to facilitate adsorption. We demonstrate that this MOF exhibits high affinity and capacity for the adsorption of both methyl paraoxon (a nerve agent simulant) and methyl parathion (a pesticide). The adsorption and reaction mechanisms, as well as possible further improvements to the MOF, will be discussed. This research contributes to the design of materials that combine adsorption and destruction of agents with possible applications in improved protective equipment.

Funding by the Dutch Ministry of Defense under CBRN Program V2207 is greatly appreciated