From the past until now, airborne contaminants are a great concern for the public health, due to the upcoming disasters, wars, industrial activities and accidents. Therefore, novel advanced low-cost media, capable to protect against emerging gaseous threats are still on a great demand. The dawn of utilizing chemicals compounds used as weapons known as Chemical Warfare Agents (CWAs) occurred during First World War, and hence, the protection of the soldiers and the staff on the war camps was of a high importance. Even though that face masks able to avoid the inhalation of toxic compounds were efficiently developed, protection media for the entire body were still needed. According to the existing reports, the modern CWAs are various and contain unknown compounds that cannot be blocked by the existing protection media, since physical adsorption is inefficient. Thus, the need for reactive media that not only block but also decompose catalytically the toxic compounds are of a great demand. Apart from the upgrade of protection media for the army, there is a need to have available cheap options for the protection of populations in urgent cases. Recently, this was obvious during the early stage of Covid pandemic, that many countries run off the cheap and easy to make disposable face masks. Similarly, the fear of a potential accident at a nuclear station or a hazardous industry should be overcome by creating effective and cheap “tools”.

Porous carbons were initially used during the First World War to fill the canisters of the face masks and are also used up today intensively for various filtration applications, like gas masks, car cabin filters, AC filters etc. The main challenge is the transition from carbon powders to carbon filters, in order to have an easy use to plenty of applications. During the last years, due to the advancements in nanotechnology, the option to prepare textiles made from nanoporous carbons is provided. Even though these textiles can have elevated removal efficiency against various pollutants, they have some crucial disadvantages. The most important are that their efficiency is based on adsorption phenomena and that if the maximum adsorption capacity will be reached, the textile is not active anymore. For instance, carbon textiles can adsorb only limited amounts of specific toxic vapors, such as the blister agent mustard gas and various nerve agents. Hence, the modification of these textiles with reactive materials capable to multifunctionally purify air streams from toxic compounds by adsorption and (photo)catalysis is crucial, whilst will possess the ability to detect the toxic compounds by change in color or in conductivity.

The main goal of this research project is to design and fabricate a new class of advanced **nanoengineered multifunctional (nano)porous composite carbon textiles**, herein called as **smart CCTs**, that can be used either as a protective layer of warfighters’ garments, or flexible part of gas masks and other paraphernalia (glows, socks etc.), as well as for easy to use single-use/disposable face masks for public protection against chemical warfare agents (CWAs) and other toxic gaseous pollutants. The target application of CCTs development was chosen due to a paramount civilizational and societal importance – protection from toxic airborne contaminants. Since the fabricated CCTs will be mechanical stable and flexible/elastic, their appliance can be expanded for other scopes like ACs filters, curtains, car cabinet filters, war emergency protection towels and blankets. Moreover, the obtain knowledge will be applied to create alternative porous carbon bases remediation composite media that can be used against other potential pollutants, like formaldehyde and radioactive sprays. Finally, the photoactive MOF-based composites will be tested as (photo)catalyst for other environmental and sustainable reactions, like biomass valorizations.