The overuse of Earth's resources in favor of civilization growth has reached an unprecedented level causing a serious deterioration of the propitious atmosphere/environment on our Planet. The decrease of the bio-capacity to balance the ecological footprint and/as well as the intensive utilization of fossil resources responsible to a great extent for global warming and for the increased amount of environmental pollutants are currently some of the most pressing environmental and societal issues that need to be addressed urgently. In this context, the scientific community is currently seeking to develop novel sustainable and renewable technologies to tackle these current environmental and societal problems, notably in the field of functional materials. As its name suggests, functional materials are materials that possess one or several properties controllable by an external command/stimulus. They carry therefore a great potential over numerous possible applications in electronics, energy conversion, medicine and so on.

The aim of this project is to develop a universal eco-friendly "smart matrix" that can be the foundation to achieve various improved functionalities in electronic materials with an increased durability. For this purpose, it is envisaged to construct various materials using efficient and green methodologies to target two important current global challenges: efficient solar energy conversion and water detoxification.

As the first objective, we will develop a novel technology mimicking natural photosynthesis to convert solar energy into electricity and chemical fuels. The novel "smart matrix" based on a widely used organic compound, viologen, will be designed to generate an efficient interface between a conductive transparent surface and the natural photoenzymes, such as Photosystem I (PSI), capable of absorbing light in order to catalyze chemical reactions. Indeed, to achieve high photo-conversion efficiency, it is important to improve the electronic communication between the PSI biophotocatalyst and the electrode surface, which will be the role of the novel well-organized "smart matrix". It is anticipated that the development of much-improved solar energy conversion in these novel nanosystems with enhanced durability will be a major advancement for biophotovoltaics and solar-to-fuel technologies.

As the second objective, we will investigate the capability of this novel "smart matrix" to capture water-soluble pollutants. Indeed, the chemical structure of the envisaged responsive matrix promotes the possibility to create strong affinities with the specific pollutants recognized as a priority in the list of the US Environmental Protection Agency. Due to their numerous properties, the novel smart materials developed in this project will also be tested towards the controlled release of the captured pollutants by the application of external stimuli including light and electricity. The confirmation of the controllable pollutant capture/release in this proof-of-concept system will constitute a major breakthrough for sustainable water detoxification applications with the use of recyclable decontaminating material.