The aim of the project is verification of hypothesis that electrochemical degradation of selected veterinary drugs and pesticides present in the environment using purposely tailored electrochemical reactors (ECRs) with innovative sp^3 carbon-based electrode materials can effectively and safely reduce their environmental impact and toxicity. The hypothesis will be verified through a series of interdisciplinary studies, including the design, construction and testing of ECRs with prototype electrodes and their use to decompose test mixtures containing the most common veterinary drugs and pesticides in the environment. The resulting solutions will be subjected to physicochemical and toxicological tests to identify the resulting breakdown products and their effect on cell lines and living organisms (Fig.1).

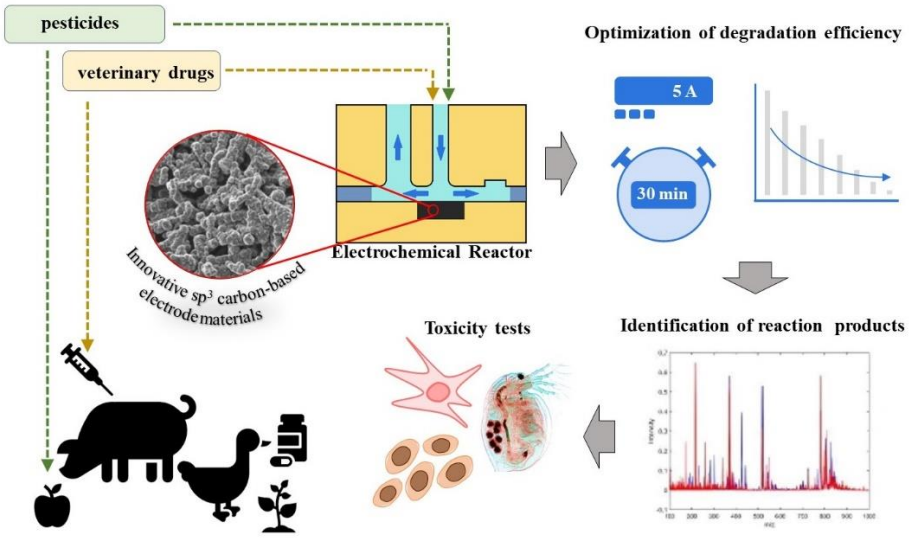

Fig. 1 Comprehensive assessment of degradation processes and products toxicity of environmental pollutant mixtures

The project's novelty will pertain to the development of innovative sp^3 carbon-based electrodes embedded in tailored batch and flow-through reactor used for electrochemical decomposition, the identification of the products of this decomposition and the toxicity of a mixture of different, specifically selected analytes at concentrations corresponding to environmental levels. A mixture of veterinary drugs (amoxicillin, doxycycline, tylosin, paracetamol, levamisole) and pesticides (glyphosate, metazachlor, flufenacet, spiroxamine, diuron) have been selected for this study. A review of the literature indicates that electrochemical advanced oxidation processes (EAOPs) using conductive diamond electrodes represent a perspective approach for the non-selective degradation of environmental pollutants. Implementation of the project will contribute to the expansion of knowledge regarding the mechanism of electrochemical decomposition of xenobiotic mixtures, and in particular, information regarding the potential decomposition products formed and their toxicity.

Due to the interdisciplinary nature of the research, it is necessary to carry it out in cooperation with experts in environmental and material sciences, electrochemistry, veterinary toxicology and analytical chemistry from Polish and Czech scientific centres: (FZU - Institute of Physics of the Czech Academy of Sciences, Prague, Czech Republic; CU - Department of Analytical Chemistry, Charles University, Prague, Czech Republic; UPWr - Wrocław University of Environmental and Life Sciences, Poland; PIWet - National Veterinary Research Institute, Pulawy, Poland).The research plan is based on the close cooperation of all involved partners: A) Design, fabrication and tuning of properties of 2D and 3D conductive sp^3 carbon electrodes (FZU), B) Designing and fabrication of ECRs (CU, FZU), C) Performance testing of developed electrodes and ECRs designs in EAOPs and research on optimal operation conditions for degradation of model xenobiotics (CU, UPWr), D) Identification of decomposition products of veterinary drugs and pesticides and their mixtures in the presence/absence of inorganic ions (CU, PIWet), E) Ecotoxicity assessment of pre- and post-reaction mixtures (UPWr), F) Cytotoxicity assessment of pre- and post-reaction mixtures (UPWr), G) Application of developed test system for testing water samples from abattoirs and livestock farms (CU, PIWet, UPWr)

The developed methodology will be applied to the laboratory analysis of real wastewater samples. The research may lead to new practical solutions for environmental protection in the field of removing harmful compounds from the environment.