WHAT ARE NITRO-AROMATIC COMPOUNDS? Nitro-substituted aromatic hydrocarbons (NARs) are indispensable in the manufacturing of a number of products that are considered as important achievements of the modern technology This includes among others, photographic films, corrosion retarders, polymers, herbicides as well as dyes Also NARs are present in exhausts of every diesel engine. This means, that humans can be easily exposed to NARs, which links with a serious health risks. NARs reveal genotoxic properties, and as such they have been identified as one of the major chemicals posing the risk of lungs, bladder, pancreas and in case of children also urinary track, and neurological-related cancers. As the result, NARs significantly contribute to the over 9.6 million deceases each year, while up to half of these could be dodged by avoiding key risk factors, including NARs.

DO YOU KNOW?

According to International Agency for Research on Cancer (IARC) all of NARs found in an engine exhaust gases can cause cancer

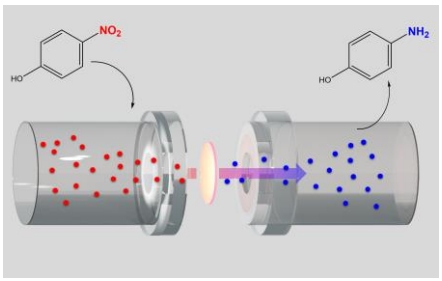
WHAT CAN WE DO ABOUT THIS? Fortunately, NARs can be recognized as important by-products for production of aromatic amines (AAMs). As such, proper processing of NARs can result in the production of AAMs, which are essential fine chemical products. AAMs are crucial for various branches of industry, being key building blocks for the production of *i.a.* paracetamol, ibuprofen, acetaminophen (alternative to aspirin), bicalutamide and nilutamide (antiandrogens), linezolid (antibiotic for multidrug resistant Gram-positive bacteria), and fosamprenavir, the anti-HIV drug, that found to be also effective in the treatment of COVID-19.

WHAT IS THE PROBLEM THEN? The most popular methods for production of AAMs is direct catalytic and non-catalytic reduction of NARs. However, methods for carrying out these processes are already recognized as inefficient, and environmentally unsustainable. Because of this, much attention is put to the catalysts consisting of nanoparticles (NPs) of noble metals, such as Au, Pt and Pd. However their practical potential is limited, as NPs are often unstable. Also, the separation of NPs from the reaction media is difficult. This is important because it should be definitely possible to recover the resultant AAMs for the further use

HOW THE PROJECT ADRESSES THESE ISSUES? The project aims to link major issues associated with the health and environmental hazards arising from the occurrence of NARs with simultaneous synthesis of AAMs. **As such, we will use wastes containing NARs for the production of AAMs**. To achieve this we will develop new methods that will enhance NARs reduction by increasing catalytic activity, and a catalyst stability, as well as will enable facile separation of AAMs.

HOW DO WE DO THIS? Within the project, we will increase catalytic activity of NARs reduction by developing new nanocatalysts (NCats) with rhenium NPs (ReNPs). These rare, and truly unique NPs will be then immersed in polymers that will lead to the formation of polymeric nanocomposites (pNCs) that will enhance stability and reusability of ReNPs. Finally pNCs with ReNPs will be designed in a way that will enable simultaneous reduction of NARs and separation of their AAMs.

HOW DOES IT WORK? The simultaneous reduction of NARs and separation of AAMs will be carried out using column- or dialysis-based processes. The principle of the latter one is displayed in the Figure on the right. Once contacted with pNC (structure in the middle), NARs will reduce in the chamber on the left, while the resultant AAMs will be transferred to the right one. Analogously, in the column-based separations, NARs will flow through a pipe-shape column being subjected to reduction, while resultant AAMs will be separated. All of the designed chambers and columns will be produced using 3D printer, while the research on properties of pNCs leading to the project goal (catalysis-separation processes), will include advanced techniques, such as High Resolution Electron Microscopy.



Dialysis based catalytic-separation system. System operates due to the pNCs membrane placed in the middle between two chambers. NARs in the left chamber are being reduced and transferred to the right chamber in form of AAMs

WHAT WILL BE ACHIEVED? The project focuses on the development of both, processes and materials enabling on the one hand, neutralization of NARs and on the other hand, production of AAMs. If successful, it will result in the entirely new systems allowing comprehensively resolve hazards arising from the occurrence of NARs and production of AAMs.