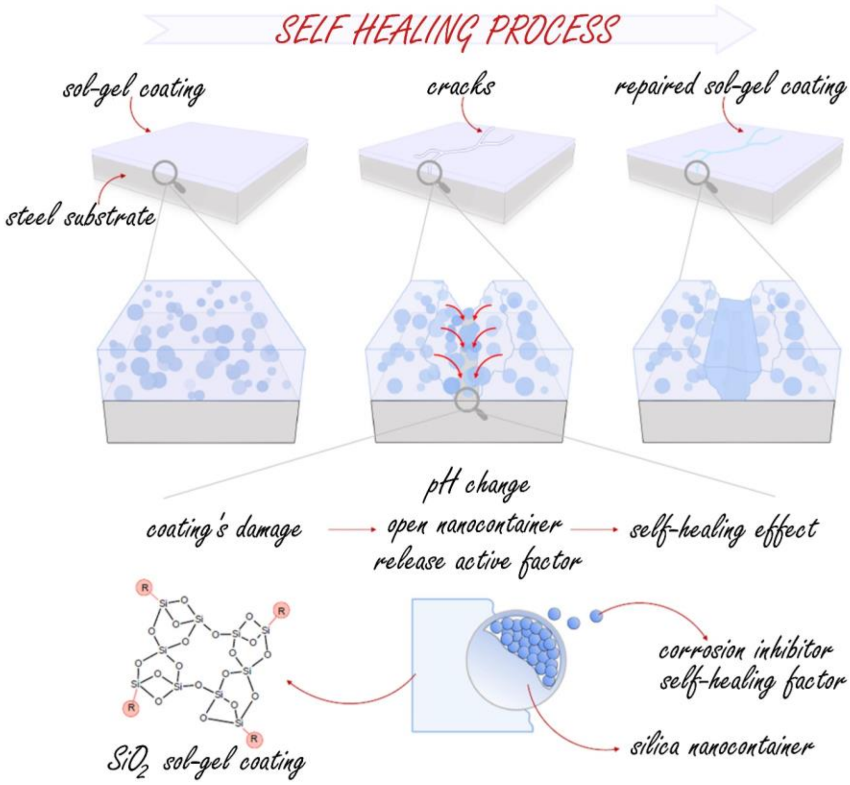
According to data from 2016, compiled by NACE (National Association of Corrosion Engineers), the costs related to the occurrence of the corrosion phenomenon amount to 3-4% of the global gross domestic product. Until 2007, one of the most effective solutions in the fight against corrosion were materials based on chromium (Cr (VI)). However, due to carcinogenicity and toxic effects on the environment, these materials have been withdrawn from use (EU Directive 2000/53 / EG). Currently, the aim is to obtain equally effective protection against corrosion as materials based on Cr (VI). Moreover, taking into account the conditions that accompany the corrosion processes, i.e. stress/abrasion/erosion, more and more emphasis is placed on optimizing the functionality of corrosion protection using coating materials. One type of such protective coatings are those based on ceramics. Unfortunately, this requires expensive equipment and in many cases the obtained results are not satisfactory. Another way to improve the anticorrosive and mechanical properties of the surface is to use the sol-gel method. The interest in sol-gel coatings results from the relatively simple method of producing such coatings, but also from the fact that there is a chemical bond between the coating and the metallic surface.

Considering the complexity of the degradation processes of anti-corrosion coatings, the main goal of the project is to obtain corrosion protection for carbon steel through the use of active, submicron silica-based sol-gel coatings. For this purpose, based oxide matrices will be modified with zirconium (Zr) and cerium (Ce) compounds. As a result of the conducted experiments, long-term protection against corrosion will be obtained, with the ability to "self-healing", while maintaining resistance to mechanical loads of various nature, including very high cycle fatigue (VHCF).

The comprehensive range of applied loads is aimed to understand the mechanisms accompanying complex degradation states of the coating. Clarification of these issues will allow for a controlled and targeted modification of steel surfaces, depending on the intensity of the destructive conditions of the working environment..



The use of nanocontainers, i.e. capsules containing corrosion inhibitors, e.g. Ce (III), and the introduction of active compounds into the silica sol-gel lattice, e.g. ZrO2, has a great potential to obtain "self-healing" coating materials, while maintaining or improving resistance to destructive mechanical stress. The invetigations planned in the project will allow to receive answer on how the structural properties of the obtained coating materials affect the protective and mechanical properties. In addition, the reactions occurring in the protective coating and on the coating-substrate interface during the operation of such a system under load conditions with the simultaneous influence of corrosive factors will be known.

Results obtained during the project realization will be used to develop models describing the influence of the environment, applied layers and the type of load on corrosion and fatigue degradation. It is assumed that the active sol-gel silica coating obtained in the project, modified with zirconium butoxide and Ce (III) - containing nanocapsules, will increase the corrosion resistance of: low-carbon P265GH and austenitic AISI 904L steels, operating under increased mechanical loads, and will delay cracks in the surface layer of substrates, thus extend the "life time" of steel materials..

The added value of the project will be creation of an interdisciplinary team, enabling the combination of knowledge from the borderline of chemistry, materials science, mechanics and modeling.