Carbon fibre-reinforced carbon matrix composite (Cf/C for short) is an essential structural material in the aerospace and military sectors. The combination of high strength and an impossibly high melting point at densities significantly lower than for competing steels is countered by a fundamental drawback: oxidation and degradation in air already above 400°C. For this reason, it is necessary to modify the material if it is to operate at elevated temperatures. Standard practice is to apply a heat-resistant SiC coating or even to convert the entire carbon matrix into SiC by infiltrating the porous matrix with liquid silicon. Despite the established position of these methods in industry, they are not without disadvantages. The disadvantage of the coating is its degradation (detachment from the substrate, cracking, evaporation) during use and a consequent reduction in its protective properties. Meanwhile, the disadvantage of replacing the carbon matrix with carbide is a significant increase in the density of the composite and, consequently, the weight of the final component. The ambition of the project is to address these problems and explore potential pathways for the synthesis of a new type of multiphase coating with longer life against high-temperature oxidation. At the same time, an attractively low density carbon material will ultimately be retained.

The main objective of the project is to discover the potential hidden in coatings consisting of silicon, zirconium and yttrium. The topic will be addressed in two stages. In the first stage, the coating will be obtained by reactive melt infiltration (RMI) of the carbon material surface with Si - Zr alloy. In the second stage, its desired characteristics will be enhanced by incorporation of Y_2O_3 nanopowder. In the final stage, the modified coating will be exposed to a series of short-term oxidation tests up to temperatures as high as 2000°C (**Figure 1**) to test its resistance to extreme operating conditions. The execution of the project will allow an in-depth analysis of the physico-chemical phenomena occurring during the synthesis by the described method, correlating observation with results in terms of microstructural, mechanical and resistance to high-temperature oxidation characteristics. The research conducted and the conclusions drawn will result in the promotion of RMI methods as a modern technique for the synthesis of heat-resistant coatings for carbon materials.

In addition, one can detail the engineering objective of the project, which is to describe the relationship between the process parameters of coating synthesis by the outlined method and the resulting coating selected properties. The will be able to be used in the design of the technological process for obtaining protective coatings for carbon materials. The guidelines provided will be able to be used in the design of the technological process for obtaining protective coatings for carbon materials.

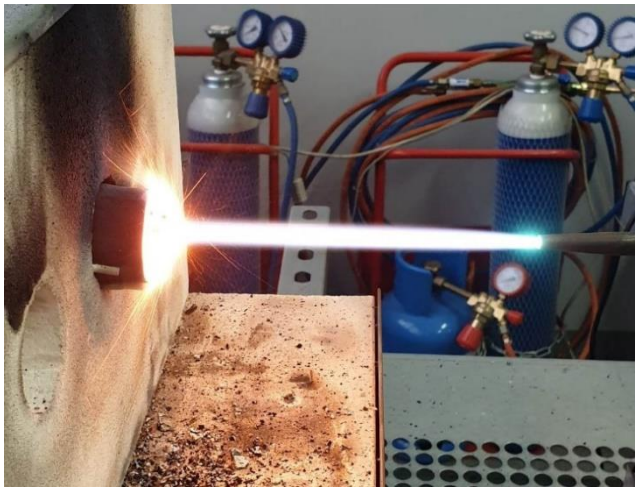

Figure 1. An example of a high temperature oxidation test (ablation) conducted in Łukasiewicz Research Network – Krakow Institute of Technology.