DESRIPTION FOR THE GENERAL PUBLIC

Nowadays, it is easy to find energy-driven devices on almost every step. The energy is produced in various ways depending on its intended use. However, it does not matter whether it is a huge power plant or a small internal combustion engine because we can definitely say, that it is the energy that drives the world we live in. It is increasingly difficult to imagine everyday life without amenities which we have access to because of electricity.

One of the biggest problems that power industry is facing is the production efficiency. The higher it is the less of expensive fuel you need to spend on production, which means cost reduction. This is very important economically because it allows for decrease of taxes. It has a direct impact on the quality of life for the citizens of a given country. As a result, it also boosts the economy because of the possibility of investing the saved money in another ways..

Gas turbines are widely used in energy industry. They allow for production of relatively big amount of energy with comparatively low cost and their sizes. However, this method has its own limitations. Because of materials used for manufacturing of key part of machine which are turbine blades. They are constantly exposed to chemically, mechanically aggressive environment together with high temperature which can cause microcavities on the surface. As a result, high temperature corrosion leads to material damage which lowers efficiency. It can proceed to destruction of the working element.

In order to prevent destructive action of the environment and improve energy production efficiency, new type of material is proposed in form of metal matrix composite with ceramic reinforcement. As a result of combining two different materials: nickel superalloy with carbides, it is possible to obtain material characterized by better mechanical resistance and ability for prolonged work in aggressive high temperature environment. The metal provides necessary shape, plasticity and is holding reinforcement in place. On the other hand, carbide particles will be responsible for better abrasion performance and higher hardness which results in slower wear of surface.

Unfortunately, production of complicated geometrically parts from metal-ceramic composite is troublesome. But it isn't necessary to obtain whole turbine blade. Surface area strengthening is sufficient. Composite coating will be deposited on the surface, in order to improve its protective properties. Application of innovative rapid prototyping method - often called 3D printing - it is possible to obtain homogenous coating. The proposed laser cladding technique offers great process control at every step of production. In contrast to classical 3D printing, laser cladding uses electromagnetic radiation beam to melt substrate material in form of powder or wire. The method allows us to design and obtain practically any desired shape. In addition, it provides the opportunity to efficiently regenerate damaged parts without interfering with the internal microstructure of the base material.

Planned project is divided into four stages. Each of the them is focused on different task. In the first one, initial mixtures will be prepared from powder substrates: metal - nickel superalloy and ceramics - selected carbide. In order to obtain protective coating of good quality, morphological analysis of powder mixture is necessary. It will allow to predict potential behavior of material during laser action. The next step is to produce policrystalline composite on the previously selected metallic base material. For this purpose, a powder mixture will be delivered by the carrier gas to the laser cladding head, where it will be deposited onto the base material. As the result of radiation absorption, powder particles will be partially melted. The moving laser head will allow production of protective layer. In the following step, obtained coatings will be prepared for analysis that includes microstructure observations, thermal analysis and mechanical tests. This will allow to optimize the parameters of the laser cladding process for the best quality of produced composite. In the last stage of the project, the results will provide information to describe phenomena in the material during laser treatment.

Description of physicochemical phenomena occurring in the material during laser action is necessary to fully understand the kinetics of the laser cladding process. It will allow to develop a research methodology for the future research of new composites. In addition, the results might be an introduction to potential practical application studies. This can have a direct impact on the development of the power and aerospace industry, where gas turbines are commonly used.