# PROJECT PROPOSAL

## National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Metal Physics Department)

# «RESOURCE SAVING HIGHLY EFFICIENT TECHNOLOGY OF LIGHT CONSTRUCTIONAL ALLOYS SURFACE STRENGTHENING AND EDUCATIONAL-MANUFACTURING LABORATORY OF ADVANCED SURFACE STRENTHENING TECHNOLOGIES CREATION»

**The problem solution of which requires to involve of international technical support:** energy and resource saving; increasing the operating life of products made from light constructional alloys is one of the most important problems in the aircraft industry, space technology, machine engineering, medicine (including – in orthopedics).

**NTUU "KPI" researchers developed** basic background surface strengthening technology of products made from aluminum alloys due to low temperature mechanical nanostructuring in quasi-hydrostatic compression conditions (by ultrasonic kick treatment – UKT).

**Advantages of new resource- and energy-saving technology proposed:**

- More efficient compared with traditional thermo-mechanical treatment of aluminium alloys surface strengthening (up to 600%) due to low temperature mechanical nanostructuring under quasi-hydrostatic compression;
- Metal products' wear resistance increasing (up to 6 times) due to synthesis of high strong (up to 10 GPa) nanocomposite coatings using dispersed powders of carbides, borides, nitrides oxides, carbon nanotubes;
- Synthesis of strong (12HPa) oxide coatings with thickness of several tens of micrometers;

- Improving of adhesion between hard coating (prepared by chemical or physical vapour deposition) and a substrate, which has been strengthened preliminarily by UKT;
- Operating life of medical products – titanium hip implants – increases due to deposition of cylindrical grooves grid by UKT method:
  - specific surface area increases in 2 times compared with untreated surface;
  - surface layer strength and hole implant bending strength increases in 3 times;
  - fatigue strength increases in 2.5 times due to compressive stresses formation;
  - adhesion of implant with bone patient's tissue increases.

**Purpose and objectives of the project proposed:** basing on NTUU "KPI" researchers results to develop experimental-industrial prototype of highly efficient energy and resource saving technology of light constructional alloys surface strengthening by ultrasonic kick treatment and to create a modern laboratory and technological base for training of world level physical material scientists and physical material technologists in advanced surface strengthening technologies, and also for carrying out in future new promising research in this area.

**Due to the international technical support should be made:** a drawing of the experimental unit for surface strengthening and its production by these drawings, purchase necessary technological equipment and creation on this basis educational and manufacturing laboratory of advanced technologies of light constructional alloys surface strengthening for aerospace engineering, mechanical engineering, medicine, etc.

Required technological equipment is not produced in Ukraine, but is used in Germany and in European Union countries.

**Information about potential project result recipients:** State Enterprise «ANTONOV COMPANY» (Kyiv), Joint-Stock Company "MOTOR SICH" (Zaporozhye), State Enterprise «Kyiv Aviation Plant "AVIANT"» (Kyiv), National Science Center "Kharkiv Institute of Physics and Technology" (Kharkiv).

**Expected project cost** 70,000 €.

**Expected results from the project implementation and project impact on industrial area or region development.** The project implementation will allow to realize at modern level the newest research results and developments of NTUU "KPI" students and researchers and their partners in a number of regional universities (in Khmelnytskyi, L'viv, Donetsk) and in the industry of Ukraine, taking it to a serial production and to markets in different regions of Ukraine and in different fields of human activity.

The project will contribute to raising the level of Ukraine's economy through the energy and resource saving, industrial production high-tech tools creation, attraction of young people to develop of a knowledge-intensive high technologies at present and in future.

Exclusively important that project results will have a positive longtime impact on development of research and technology in Ukraine in short and as well in medium term prospective.