

Research program

METAL MATERIALS AND FUNCTIONAL SURFACES

Research on influence of technological processes concerning the utility properties of materials. Research of materials intended for high-temperature applications (power engineering, jet engines, food industry), materials used in the automotive, railway and aerospace industries and materials with functional surfaces (heat spraying of metallic, ceramic and polymer materials, plasma nitriding). The aim is to assess both structural changes and changes in mechanical properties caused by the used technology, or to find and optimize workability by searching suitable process parameters or by using special technologies.



Research activities

MATERIALS FOR HIGH TEMPERATURE APPLICATIONS

- ▶ Development of new materials in the form of intermetallic compounds for applications with increased abrasion resistance at elevated temperatures. Research aimed at improving the properties of Ni alloys and martensitic and bainitic Cr-Mo and Cr-Mo-V steels or other materials working in environments with temperatures above 450 °C.
- ▶ Optimization of welding and heat treatment processes. Study of susceptibility to hot cracks and possibilities of their prediction, thermal fatigue and applicability of special welding methods (diffusion welding). Interconnection with applicability assessment and the possibility of joining additively prepared parts with parts produced by conventional technologies and also possibility of using functional surfaces on mentioned materials.

MATERIALS FOR AUTOMOTIVE AND TRANSPORTATION

- ▶ Research on the influence of technological processing regarding utility properties of fine-grained steels, IF, TWIP and TRIP steels, Al, Ti and Mg alloys. Description of processes occurring in the materials and search for procedures in order to preserve and possibly improve the properties that the material had before the technological processing.
- ▶ Assessment of influence on different types of welding cycles, on mechanical properties changes. Studies of grain growth kinetics, impact of grain size on impact value and transformation temperatures, tensothermal effects of applied technology. Study of fatigue life of weld joints from common fine-grained and HSLA steels including possibility of prediction by Dang-Van criterion.
- ▶ Study of limit deformation states regarding new types of materials at different stress states characterizing given forming technology. Using photogrammetric methods, the kinetics of fracture formation will be studied with the emphasis on high-strength steels and Al alloys intended for processing of deep-drawing technologies. Research and definition of advanced FEM models considering anisotropic transition of material to plastic state and kinematic strengthening model.
- ▶ Research of metallurgy and crystallization of selected technical alloys. Research of heat treatment of curable Al alloys in order to determine its optimal technological parameters with respect to required properties.

MATERIALS WITH FUNCTIONAL SURFACES

- ▶ Assessment of various types of functional surfaces in terms of adhesion, functionality (hardness, abrasion resistance, corrosion resistance) for molded, cast and additively formed parts including their combinations and assessment of surface properties at the joint boundary. Adhesion study of individual surface types and study of diffusion processes in materials, including determination of diffusion.
- ▶ Research of tribological processes and possibilities of influencing the stability during pressing by new functional and protective sheet coatings. Research in the field of increasing tool life of forming tools by targeted creation of various types of coatings in locally exposed places of tools.
- ▶ Development of new intermetallic surfaces by plasma powder welding or thermal spraying.