Influence of a variable strain route and forming tool parameters on structural changes and properties of ultra-low carbon and deep-drawing steels

In material engineering receiving materials which have high strength properties and maintain high plasticity is a live issue. This is particularly important in materials intended forsafety items of vehicles. In the automotive industry steel has been used for many years as the primary construction material. The reason for this is high stability properties of steel, which is obtained in known, verified and controlled technological processes. These processes have been significantly improved for performance and improvement of the production parameters over the years. Currently in bodies of vehicles conventional low carbon ferritic steels, which are processed by hot and cold rolling, are mainly used.

Interest in nano and ultra-fine-grained structure materials has increased significantly in recent years. These materials are characterized by properties which are unreachable for traditional materials. Grain refinement causes, above all, increase of mechanical properties compared with materials with a micrometric structure. In addition in ultra-fine-grained materials increase of strength is combined with retaining good ductility. Thus, production of nano and ultra-fine-grained structures is nowadays one of very significant fields of research for many research centres. Obtaining a refinement structure is possible above all due to so called Severe Plastic Deformation (SPD).

In this proposed project it is planned to conduct research of severe plastic deformation using DRECE - an unconventional technique in order to obtain an ultra-fine-grained structure of low-carbon IF steel and deep-drawing DC01 steel.

The main scientific object of this research project is a description of a variable strain route and forming tool parameters to changes of strength characteristics, plastic properties, and structural phenomena that occur during severe plastic deformation in ferritic IF and DC01 steels using the innovative DRECE method (Dual Rolls Equal Channel Extrusion).

The most important determinant to take the subject proposed in this project is the lack of detailed studies in literature (primarily domestic) concerning the application of unconventional SPD methods in order to obtain the ultra-fine-grained structure of ferritic low-carbon IF and deep-drawing DC01 steels being in addition combined with the previously carried out numerical simulation of the DRECE process . This issue is important because applicable nature of "new" IF and DC01 steels with an ultra-fine-grained structure and increased strength in relation to their baseline. These steels can be used inter alia for body components of a vehicle where nowadays other high strength materials are used. A significant increase in the mechanical properties of the IF and DC01 steels can also be a determining factor and indicates a completely **new** (than before) use of these steels (for example in the process of precision blanking of small parts).