PROJECT

High-strength electro-technical steels for electric vehicles and hybrid motors

Vysokopevné elektrotechnické ocele pre elektromobily a hybridné pohony

Funding: National (Slovakia)

Duration: Jan 2013 - Dec 2015

Status: Complete with results

Objectives:

The project is focused on the microstructural design of high-strength electrical steels for hybrid motors and electric vehicles.

Within the project the original concept of high-strength electrical steel based on composite gradient microstructure substructure and texture through the sheet thickness arrangement, will be designed.

The central part is characterized by coarse-grained microstructure with high intensity cubic texture component reinforced by coherent Cu precipitates and solid solution, characterized by excellent electromagnetic parameters. Subsurface area will consist of fine-grained microstructure reinforced by incoherent AlN precipitates and solid solution of Si, Al, Cu in the ferrite. This area is characterized by high strength characteristics and good resistance to fatigue rupture.

To achieve the selected composite system a sequence of structure creation will be designed and implemented.

Parent Programmes:

VEGA - Scientific Grant Agency

Institute type: Research agency

Institute name: Scientific Grant Agency

Funding type: Public (national/regional/local)

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Key Results:

Based on the realized experimental program and the analysis of the obtained results we can draw the following conclusions:

1. By utilizing the gradient of the strain intensity on the sheet thickness, it is possible to modify the dynamics of the growth of the columnar grains and their morphology.

2. Deformation gradient induces grain growth in steel in the direction of increasing deformation intensity. That is, the grains grow from an area with a lower deformation value to an area of higher deformation intensity.

3. The kinetics of secondary recrystallization and the morphology of the microstructure depend on the degree of applied deformation and the heat treatment conditions.

4. Application of low deformations between 2% - 4% and subsequent annealing at temperatures of 900 ° C - 950 ° C within 5 minutes in a dry hydrogen atmosphere leads to the development of coarse and under specific conditions to a columnar microstructure.

5. The deformation-induced growth of the columnar grains leads to a microstructure with increased intensity of the cubic and glossy texture component at the expense of the deformation component.

6. Column grains with a favourable cubic and Goss crystallographic orientation were grown from the structural state after primary recrystallization, which was characterized by the predominant deformation texture.

7. An increase in the cold deformation value in the 6-10% range induces grain growth with other crystallographic orientations, resulting in a homogeneous microstructure but with a finer grain compared to lower deformation cases.

STRIA Roadmaps: Transport electrification, Vehicle design and manufacturing

Transport mode: Road transport

Transport sectors: Passenger transport, Freight transport

Transport policies: Decarbonisation

Geo-spatial type: Urban