

## **The research activity during my scholarship period**

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Bilateral State Scholarship

Application number: 157305

The topic of my research was to study the lattice defects and their influence on functional properties in ultrafine-grained (UFG) materials.

In the first part of my research work, I investigated the defect structure, the phase composition, and the mechanical behavior in medium manganese steel. The as-received samples were heat-treated at 1000 °C for 30 min followed by water quenching and after inter-critical annealing at 650 °C for 30 min followed by water quenching. In these materials, the UFG microstructure was achieved by High-Pressure Torsion (HPT) for different numbers of turns (½, 1, 3, and 10 turns). The effect of the number of HPT turns on the phase composition and the microstructure were investigated by scanning electron microscopy and by X-ray diffraction line profile analysis. The HPT-processing at room temperature yielded phase transition to body-centered cubic as well as grain refinement. The evolution of the dislocation density and the grain size during HPT was investigated. We are started to prepare a journal publication from these scientific results.

In the second part of this research, we started to investigate the thermal stability of the nanocrystalline microstructure in medium manganese steel

processed by HPT for ½, 1, 3, and 10 turns by differential scanning calorimetry (DSC) up to 1000 K with heating rate 20K/min. Two peaks were observed in the DSC thermograms for both materials (650 °C and 1000 °C series). The first, an exothermic peak and related to the annihilation of dislocations. The second, an endothermic peak, was caused by a reverse-phase transformation of bcc to fcc structure.

As the period of scholarship was short and was not as we asked so the task is not finished at the end of the scholarship period, but we continue working on this project. We will find the activation energies of recovery and the energy of reverse phase transformation. The grain growth during DSC annealing and the hardness of annealed samples will be investigated also. we planned to write a scientific paper about these results.

Budapest 15.09.2021

Yours sincerely,

**Dr. Moustafa El-Tahawy**