The present work deals with grain refinement of medium carbon steel AISI 1045 having different microstructure resulting from thermal and/or thermomechanical (TM) treatment, applied prior severe plastic deformation (SPD). In case of TM treated steel, structure refinement was conducted in two steps. Preliminary steel structure refinement has been achieved due to multistep open die forging process which provided total strain of $\varepsilon_{\text{ef}} \approx 3$. Uniform and fine recrystallized ferrite structure, with grain size of the order of 2-5 µm and with nest-like pearlite colonies was received. The further grain refinement of steel samples, having different initial structure was accomplished during warm Equal Channel Angular Pressing (ECAP) at 400°C. The microstructure development was analyzed in dependence of effective strain introduced in range of $\varepsilon_{\text{ef}} \approx 2.5 - 4$. Employment of proposed deformation conditions resulted in extensive deformation of ferrite grains, where mixture of subgrains and ultrafine grain structure was found, regardless the preliminary treatment of the steel. As straining increased the dynamic polygonization and recrystallization process became active to form mixture of polygonized subgrains and sub-microcrystalline grains having high angle boundaries. The intensive straining and moderate ECAP temperature caused the partial cementite lamellae fragmentation and spheroidization as straining increased. The lamellae cementite spheroidization was more extensive in prior TM treated steel samples. The deformation behaviour of both steel structural states confirmed the strength increase. However the work hardening behaviour of steel was modified with respect to initial structure condition of the steel prior SPD deformation.

**Keywords:** Medium carbon steel, thermomechanical treatment, ECAP, grain refinement

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