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NANO-FRAGMENTATION TREATMENT OF THE STRUCTURE - BOOSTED MECHANICAL CHARACTERISTICS IN CARBON STEELS

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Abstract. The formation of a highly hardened state in materials is still an unsolved problem, if the increase of their mechanical characteristics is not simultaneously accompanied by an increase in their fracture ductility, and this is determined by the methods of Fracture Mechanics [1]. Hardening is strongly dependant on the internal obstacles [2,3] that stop dislocation motion. The larger the resistance to the dislocational barrier, the stronger the hardening effect. Some results about the hardening effect in a carbon steel 08KP through the application of the nano-fragmentation method of the structure, are presented in this work.

At present, the development of new materials is determined not only by the viability of applying the physical processes for their attainment but also by the economic evaluation of their rational usage [1]. The exploitation of metals and alloys in the plastic range demands the use of more profound concepts to evaluate their fracture resistance. The existing methods for improvement of the mechanical properties of crystalline metals lastly lead to the formation of internal barriers within the metal capable of hindering in an effective manner the dislocation movement, as shown in Figure1, which play a fundamental role in the energy transport transmitted to the metal during their deformation process at slightly low temperatures [2, 3]. The effectiveness of the hardening treatment is determined, before anything else by two factors: 1) The efficiency of the dislocational obstacles to stand stress with which dislocation act upon them and; 2) The distance between barriers.

Attempts for the interpretation of Fractographic studies have been done, from the point of view of fracture mechanics [4]; nevertheless the legitimacy of those attempts incite certain doubts.

Considering that the ductility characteristics of fracture are fundamental when the capacity of work of a structure is evaluated, the need for their determination emerges, using specimens with small dimensions. These methodologies are required to be performed, especially when new steels are formulated with ultra-high resistance and when new technologies are developed for the hardening of the current steels. In the present work some results of research developed in this direction are discussed.

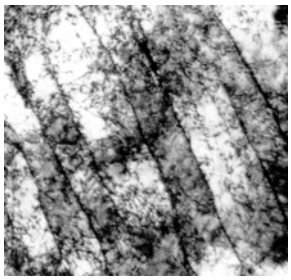

Figure 1. Dislocational structure in a 08KP hardened steel (×37500).
Transmission electron microscopy image obtained in a JEOL 1000 microscope.

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