Fatigue resistance of dual phase steels in presence of microstructural inhomogeneities

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In the work, there are noted experimental results aimed at determination of influence of initial microstructure of the steel S355, that was exposed to different temperatures of intercritical annealing, on its resistance against cyclic loading by number of cycles needed to fracture the samples, loaded by stress amplitude σ_a = 500 MPa. Intercritical annealing at temperature ranging 740-840°C was carried out on a bar with the same thickness as the steel sheet in received state (B=9mm). Fatigue tests were realized on 1,2mm thick specimen cut from subsurface and middle area of initial thickness of the plate, where a banding structure occurred, thickness ~1,5 mm in the received state. It was discovered, that samples with microstructural banding have higher fatigue resistance independently on temperature of intercritical annealing.

Keywords: dual phase steel, microstructural banding, tensile properties, fatigue resistance

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Reference

[1] BENDA, Y.: Fatigue behaviour of advanced high strength steels for automotive applications, *American Iron and Steel*, Ispat Inland Inc., February 2003.

[2] FORREST, P.G.: *Fatigue of Metals*, Pergamon Press LTD, Oxford, 1962.

[3] HÄRKEGÄRD, G.: An experimental study of the influencee of inclusions on the fatigue properties of steel, *Engng Fracture Mech.* 6 1976 795-805.

[4] MURAKAMI, Y. AND USUKI, H.: Quantitative evaluation of effects non-metallic inclusions on fatigue strength of high strength steels. II Fatigue limit evaluation based on statistics for extreme values of inclusion size, *Int J Fatigue* 11 (1989) 5 299-307.

[5] SHIOZAWA K, LU L, ISHIHARA S. S–N curve characteristics and subsurface crack initiation behavior in ultra-long life fatigue of a high carbon–chromium bearing steel. *Fatigue Fract Eng Mater Struct* 24 2001 12 781–90.

[6] SHIMATANI, Y., SHIOZAWA, K., NAKADA, T., YOSHIMOTO, T. AND LU, L.: The effect of the residual stresses generated by surface finishing methods on the very high cycle fatigue behavior of matrix HSS, *Int J Fatigue* 33 (2011) 122–131.

[7] BERETTA, S., BLARASIN, A., ENDO, M., GIUNTI, T. AND MURAKAMI, Y,: Defect tolerant design of automotive components, *Int J Fatigue* 19 (1997) 4 319-333.

[8] KURITA, M., YAMAMOTO, M., TOYAMA, K., NOMURA, S. AND KUNISHIGE, K.: Effects of strengthening mechanisms on fatigue properties of ferrite-pearlite hot-rolled sheet steel ISIJ *Int. 36* (1996) 4 481-486.

[9] SUDO, M., HASHIMOTO, S.I. AND KAMBE, S.: Niobium Bearing Ferrite-Bainite High Strength Hot-rolled Sheet Steel with Improved Formability, *Trans. Iron Steel Inst*. Jpn. 23 (1983) 303-311.

[10] SHANG, J.K., TZOU, J.L., RITCHIE, R.O.: Role of crack tip shielding in the initiation and growth of long and small fatigue cracks in composite microstructures, *Met. Trans*. 18A (1987) 9 1613-1627.

[11] ZHONGGUANG,W., GUONAN, W., WEI, K. and HAICAI, H.: Influence of the Martensite Content on the Fatigue Behaviour of a Dual-phase Steel, *Mater. Sci. Eng*. 91 (1987) 7 39-44

[12] WÄNNMAN, L. and MELANDER, A.: Influence of Martensite Contents and Properties on Fatigue Behaviour of Dual-Phase Sheet Steels, *Mater. Des*., 12 (1991) 3 129–132.

[13] ROSENBERG, G., GAŠKO, M., SINAIOVÁ, I., KOČÍK, M., JUHAR, Ľ.: Fatigue behavior of hot-rolled steel intended for cold forming, *Materials Engineering*-Materiálové inžinierstvo 18 (2011) 4 63-67.

[14] HILDITCH, T., BELAD, H., HODGSON, P., STANFORD, N.: Role of microstructure in the low cycle fatigue of multi-phase steels, *Mater. Sci. Eng*. A 534 (2012) 288– 296.

[15] WANG, Z.G. AND AL, S.H.: Fatigue of Martensite-Ferrite High Strength Low-alloy Dual Phase Steels, *ISIJ International*, 39 (1 999) 8 747-759.

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