Evolution of Microstructure and Mechanical Properties in Steels during Isothermal Holding in the Region of Bainitic Transformation Temperature in Dependence on Silicon Content

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Under isothermal treatment conditions, bainite transformation involves decomposition of austenite into a non-equilibrium structure consisting of needles of super-saturated bainitic ferrite and carbide precipitates. Similarly to martensitic transformation, bainitic ferrite forms by shear mechanism. Owing to relatively low temperature, only interstitial elements, predominantly carbon, can migrate by diffusion. Depending on the transformation temperature, carbon migrates from ferrite and forms carbides, either within bainitic ferrite needles and at the interphase interface between bainitic ferrite and austenite, or only within bainitic ferrite needles. In conventional steels, bainite transformation continues until the decomposition of austenite phase is almost complete. If the steel contains enough silicon, carbide precipitation may be suppressed or even prevented altogether. In such case, carbon which diffuses from the needles of bainitic ferrite may enrich adjacent austenite areas. Depending on heat treatment conditions, the carbon-enriched austenite may become sufficiently stable to resist decomposition and remain in the microstructure.

Keywords: Bainite transformation, influence of silicon, isothermal transformation, carbidic bainite, carbide-free bainite

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References

[1] BHADESHIA, H., CHRISTIAN, J. (1990). Bainite in steels. *Metalurgical transactions A.*, Vol. 21A, pp. 767-797

[2] MAZANCOVA, E., (2012). *Technické materiály I.,* VŠB – Technická univerzita Ostrava, Ostrava, 150p

[3] CABALLERO, F., BHADESHIA, H. (2004). Very strong bainite. *Current opinion in solid state and material science,* pp. 251-257.

[4] CHANG, L. (1999). Bainite transformation temperatures in high-silicon steels. *Metallurgical and materials transaction A*., Vol. 30A, pp. 909-916

[5] GARCIA-MATEO, C., CABALLERO, F., G., BHADESHIA, H. (2003). Development of hard bainite. *ISIJ International*., Vol. 43, pp. 1238-1243

[6] KOTESOVEC, V. (2016). Impact of quenching temperature and isothermal holding time during austempering on bainite content in high silicon steel. *4th International conference recent trends in structural materials.,* November 2016

[7] KUČEROVÁ, L., JIRKOVÁ. H, Š., KÁŇA, J., (2016). The Suitability of 42SiCr Steel for Quenching and Partitioning Process. In: *Manufacturing Technology*, Vol. 16, No. 5, pp. 984-989. ISSN 1213□2489

[8] AISMAN, D. JIRKOVA, H. RUBESOVA, K., JENICEK, S. (2016). Mini-Thixoforming of Low-Carbon High-Alloy Steel. In: *Manufacturing Technology*, Vol 16, No. 5, pp. 845-849. ISSN 1213□2489

[9] VOREL, I., JENÍČEK, Š., KÁŇA, J., IBRAHIM, K., KOTĚŠOVEC, V., (2016). Use of Optical and Electron Microscopy in Evaluating Optimization by Material-Technological Modelling of Manufacturing Processes In-volving Cooling of Forgings. In: *Manufacturing Technology* , Vol 16, No. 6, pp. 1383-1387. ISSN 1213□2489

[10] VANDER VOORT, G. (2004). Metallography and microstructures. *ASM Handbook.* ASM International, Vol. 9

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