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Gradient nature shaping of the 20X2H4A steel structure as a carbonitriding result

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The study of the shaping of the gradient structure nature appearing in constructional alloy martensite 20X2H4A steel (0.2%C, 2%Cr, 4%Ni), as a result of surface saturation by carbon and nitrogen (carbonitriding) at 920℃ in industrial conditions is made in present work by methods of optical and transmission electron microscopy.

20X2H4A steel is a multiphase material, consisting in α and γ phases, and cementite $(Fe,Cr)_3C$, alloyed by Cr in initial state but α and γ phases, $(Fe,Cr)_3C$ carbide and $(Cr,Fe)_{23}(C,N)_6$, $(Cr,Fe)_2C_{0.61}N_{0.39}$ and $(Cr,Fe)_{6.2}C_{3.5}N_{0.3}$ carbonitrides after carbonitriding.

The volume part of the phases and grain sizes are changed in a complicated manner depending on distances from the surface of the material after carbonitriding. The volume part of α phase is 0.42, austenite grains －0.2 and the rest volume is occupied by the carbides and carbonitrides, one third of which is found by in the grain boundaries in the manner of lamellar form alloy cementite, the other part in grain junctions and boundaries-in the manner of $M_{23}(C,N)_6$ carbonitride particles having large sizes and the round form. The small $M_{23}(C,N)_6$ particles are located inside of grains.

The volume part of α phase reaches 0.85 at the 2 mm depth and the amount of carbides and carbonitrides decreases quickly, approaching to 0.02 value as in a zone of the main metal. The sizes of all precipitations are changing in a complicated manner: they are increasing up to 400 μm depth ($(M_{23}(C,N)_6$ carbonitride has 25 μm size and $(Fe,Cr)_3C$ carbide －23 μm size), then at the 2 mm depth they are decreasing, approaching to particle sizes in a basic metal ($(M_{23}(C,N)_6$ carbonitride size is 12 μm and carbide $(Fe,Cr)_3C$-5 μm size). Depending on the carbide amount Cr steels show the brittleness after the tempering at 600℃, which is concluded in fall of impact strength. The change carbonitride phase, sizes renders the essential influence upon the steel mechanical characteristics. The grain sizes after carbonitriding are changed in a complicated manner from the surface inside of material.

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