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Isothermal transformation austenite-ferrite in a P92 steel

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The Time-Temperature-Transformation (TTT) diagram of an ASTM A335 P92 steel (9CrMoWVNNb) has been established starting from an austenitization temperature of 1050 ℃. Isothermal transformation was carried out at temperatures from 625 up to 775 ℃ taking 25 ℃ intervals, using a high resolution dilatometer. Only two state fields (i.e., austenite and ferrite + carbides) were observed, in full agreement with previous results on similar steels. A subset of large austenite grains, with sizes significantly exceeding the mean, was observed in all of the tested samples. At temperatures below the nose of the TTT diagram, prior austenite grain boundaries were made visible by decorating them with carbides precipitated at the early stages of the transformation. Carbide decoration allowed to have an accurate picture of the size distribution of austenite grains under the prescribed conditions of thermal cycle. Above the nose, prior austenite grain boundaries are hardly seen due to a drastic change in carbide precipitation mechanisms. At the same time, the ferrite nucleation and growth is markedly different in these two temperature regions; there is a gradual transition between these two extreme behaviors.
The dilatometric curves obtained at each temperature were fitted to the Kolmogorov-Johnson-Mehl-Avrami expression in order to extract kinetic information about the austenite-ferrite transformation. Fitting was accomplished so as to take into account the presence of the large austenite grains.
At the same time, a thorough examination of the transformed samples was carried out by using optical and electron (FEG-SEM and TEM) microscopy. Carbon replicas were extracted from the surfaces of selected specimens and a detailed study of the carbides present in each case was added to the former information.

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