

The Microstructure of As-Quenched 12Mn Steel

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One of the most fascinating microstructures found in martensitic steels is that of Fe-12Mn in the as-quenched condition. This alloy spontaneously produces an ultrafine-grained microstructure on quenching from the austenite, with an effective grain size in the micron range. The as-quenched alloy is, unfortunately, liable to catastrophic intergranular fracture, but if the appropriate steps are taken to suppress this problem, the alloy has a ductile-brittle transition near 77K. The source, and, in fact, the detailed nature of this microstructure have been unclear for decades. However, recent research using a combination of TEM, EBSD and theoretical analysis offers new insight. As will be discussed, the microstructure is a laminate of thin plates of dislocated martensite laths that with predominantly twinned boundaries. Each plate contains all 6 of the martensite variants that are compatible with the martensite packet that includes the plate. The structure of the plate follows from the fact that it forms from the parent austenite through the intermediary of a planar, hexagonal epsilon-martensite phase. The overall microstructure is the simplest compatible structure that fully relaxes the shear strain of the martensite transformation.