in the transforming region, even though each atom shifts only slightly relative to its neighbors. These diffusionless and displacive characteristics distinguish martensitic transformations from all other types.

Martensitic transformations produce lenticular plates with semicoherent interfaces between plates and parent lattice. Plates grow with a velocity near the speed of sound but stop growing when (1) a grain boundary, (2) another martensitic plate, or (3) other lattice disturbances which serve as barriers are encountered. The distribution of plate sizes within a grain is not well understood. Fisher[46] suggests that plates form randomly throughout each grain, constantly subdividing grains, so later generations of plates form in smaller and smaller parent volumes. Magee[47] has proposed a somewhat different order of growth in which nucleation is not random throughout each grain, so at any time some grains will contain martensitic plates and some will not. These plates tend to occur in clusters, with various-sized plates in each cluster. It has been observed that the first detectable amount of transformation is due to the presence of single clusters of plates[47] in several grains, in contrast with Fisher's model. Further transformation largely involves spreading of clusters to untransformed regions. To a first approximation, volume of newly-formed plates in a cluster is constant. This picture leads naturally to the conclusion that increments in volume of the new phase are proportional to increments in the number of nucleation centers activated.

5.2.1. Crystallography

Martensitic growth causes bulk shape changes, from such causes as tilting of the martensitic plates, which are visible at flat free surfaces. The plates are surrounded by untransformed matrix and are usually lenticular, although in some steels "needles" or "laths" have been reported. These plates may in turn contain a fine structure of slip bands or twins as a direct consequence of the transformation process.[48]

The martensitic plate has mirror symmetry about a plane, and this plane has a particular and reproducible orientation with respect to the parent phase for any lattice. The plane in the parent lattice which lies parallel to the symmetry plane of the martensitic plate is called the habit plane. It is the plane along which the principal shear displacement occurs in the martensitic reaction.

Consideration of experimental data on martensitic transformations has encouraged development of crystallographic explanations for any particular transformation of orientation relationships, habit planes, deformation shapes, and nature of the fine structure within the martensitic plates.

Bowden, et al.[31] concluded that markings from recovered shocked alpha iron samples resulted from shear transformation to the epsilon phase, body-centered-cubic (bcc), to hexagonal-close-packed (hcp) and its reversal, which suggests that the transformation is martensitic. The shear mechanism, reviewed below, is essentially the same as proposed by Burgers[49] for the zirconium transformation.