thickness by wave velocity. Smith[24] has suggested that the plastic II shock front width in iron is less than 0.02 mm, based on metallurgical data. This shock width implies a rise time of about 0.005 μsec.

To interpret some of the above experimental results, Horie and Duvall[20] developed a model of mixed phases which contained a constant relaxation time parameter. This relaxation time has to be evaluated from experimental data. In considering available data, they found a relaxation time of 1/3 μsec based on rise time measurements of Novikov, *et al.*[23] for the plastic II shock front, of 0.01 μsec based on the plastic II shock front width of less than 0.02 mm reported by Smith,[24] and of 20 μsec based on the slow decay of the plastic I stress observed by Minshall.[22] A relaxation time less than 0.05 μsec is required to explain my data on decay of the plastic I stress, while Barker and Hollenbach[15] found that a relaxation time of 0.16 to 0.18 μsec was required to explain their data on plastic I stress decay. The disagreement among values of relaxation time impugns the validity of the Horie and Duvall[20] assumption of constant relaxation time.

1.2.3. Evidence for Non-equilibrium Behavior of Mixed Phases

Experimental and theoretical evidence exists which suggests that in the pressure range of 130 to 300 kbar, iron is not in equilibrium and/or the transformation does not go to completion. The more pertinent results are summarized in this section.

At least two theoretical attempts have been made to understand the iron Hugoniot data between 130 and 300 kbar. Duvall and Horie[26] demonstrated that the calculated slope of the equilibrium phase line in pressure-temperature space differs significantly from the measured slope. More recently, Andrews[27,28,29] calculated the equilibrium Hugoniot for iron and found it to differ from Hugoniot data between 130 and 300 kbar. The conclusion from both treatments is that dynamic transformation data do not agree with equilibrium thermodynamics.

Single crystals of silicon iron have been subjected to x-ray diffraction and metallographic analysis after exposure to shock waves and relief waves which caused the formation and disintegration of the epsilon phase.[30] As a result of this cycle of transformation, one would expect single crystals to be transformed into polycrystalline aggregates. The diffraction analysis shows that the material had retained in large measure its original orientation, though it was polycrystalline. There are two possible explanations for this. The first is that the alpha to epsilon transformation and its reversal are crystallographically reversible to some extent.[31] The second, suggested by German, et al.,[30] is that the transformation does not go to completion. This suggestion appears to be in better agreement with various experimental results.

Much of the experimental evidence implying non-equilibrium behavior comes from the results of static isothermal compression