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# Macroscopic Dynamics of Phase-Transition Front and Straight Brittle Crack

**Arkadi BEREZOVSKI**

Centre for Nonlinear Studies, Institute of Cybernetics  
Tallinn University of Technology, Estonia

Email: Arkadi.Berezovski@cs.ioc.ee

The problem of the propagating phase-transition front in solids arises in the context of dynamics of martensitic transformations, which provides a hysteretic behaviour of shape-memory materials. Phase boundaries can be represented at the continuum level as surfaces of discontinuity. However, classical elastodynamics provides no information about the kinetics of moving discontinuities. This problem also relates to the thermodynamic description of displacive (diffusionless) phase transformations. This is why the problem attracted the attention of many researchers during last two decades.

Additional constitutive information is usually provided in the form of a kinetic relation between the driving force and the velocity of the phase boundary. The form of the kinetic relation is still under question, but the asymptotic behavior of the kinetic curve is well understood [1].

The main idea of the paper is to use the *local phase equilibrium conditions* at the phase boundary to determine the value of the stress jump at the discontinuity. This stress jump relates to the driving force, which allows then to derive the kinetic relation by means of the jump relation for linear momentum. The difference between local phase equilibrium conditions and classical equilibrium conditions is due to the total entropy, which is conserved in the classical full equilibrium, but this is not the case in the local phase equilibrium.

We describe both the crack dynamics and the phase-transition front propagation in parallel to emphasize similarities and distinctions in the application of the general theory to these different problems.

The whole consideration is performed in the framework of the material setting of continuum mechanics [2]. The material setting is necessary because the driving force concept is used consequently. A non-equilibrium description due to the irreversibility of phenomena is taken into account by means of the thermodynamics of discrete systems.

The derived kinetic relations depend on assumptions concerning the excess stress at the discontinuity. These assumptions may be a subject for further generalizations and improvements.

## References

- [1] Abeyaratne, R., Knowles, J.K.: *Evolution of Phase Transitions: A Continuum Theory*, Cambridge University Press, Cambridge, UK, 2006.
- [2] Maugin, G.A.: *Material Inhomogeneities in Elasticity*, Chapman and Hall, London, 1993.