Abstract

In this work a field theory of plastic deformation of crystals - considering dislocations and dislocation networks contributing to the plastic deformation - is constructed in the framework of Lagrange formalism.

The elasto-plastic medium is described by means of the *generalized Cosserat continuum* which allows the description of non-linear elasticity and plastic deformation due to the Cosserat continuum being a fluid with a substructure (the so called Cosserat vectors), meaning that fluid-like behaviour characterizing the plastic deformation is automatically included in this theory. The traditional tensor of dislocation density, however, lacks the capability of describing interaction of dislocation on microscopic scales, especially in so called dislocation networks.

The plastic flow therefore is based on the motion of dislocations described by the means of *dislocation classes*. These classes are subcontinua, in which dislocations with the same characteristic vectors are combined and their dynamics are modelled by ideal fluids. Therefore it is possible to describe the interaction in dislocation networks, which is shown by an example: a distribution of dislocations forming a network, which obstructs the motion of the dislocations and thereby the plastic deformation, leading to the well known *work hardening*.
Further a dispersion relation of a Nye structural curvature, where one dislocation class is dominating, and the plastic flow following from a distinct dislocation motion is analytically calculated.

In the last chapter a two-fluid-model is developped, which integrates dissipation in the Lagrange formalism using the Thermodynamics of irreversible processes within Lagrange formalism developped by Anthony. This model can be inserted into the Lagrangian of the dislocation dynamics which is also based on fluids - the fluids of the Cosserat continuum and the dislocation classes.

Finally a Lagrangian is constructed which describes the dynamics of plastic deformation of crystals under consideration of the dissipative motion of dislocations.