The recent trends in the modern materials engineering are focused on the structural materials which represent high strength and good ductility. Nanostructured Multilayered Materials (NMM) seems satisfy these expectations. The main advantage of the NMM is a significant increase in strength and change in physical properties. This opens up the possibilities for their broader application in innovative industries such as transport, energy and bioengineering. NMM materials exhibit a very high strength due to interaction between many strengthening mechanisms. For many of the applications (high stress, dynamic loading, fatigue) it is desirable to not only understand mechanical behaviour but also to predict it. Currently, the ability to do this is limited due to the lack of understanding of the microstructural evolution sustained by materials under dynamic loading conditions and physical representation of this understanding within high rate plasticity models. The development of this knowledge of the microstructural and substructural evolution during deformation will allow us to build new constitutive models for predicting the behavior of modern, nanostructured multilayered materials. Such materials have already passed their first tests for industrial maturity – currently available technologies allow obtain them in relatively large quantities (in the form of plates or strips), but only in limited materials range. Unfortunately, while the mechanical response of many metals and alloys is well understood under more conventional loading rates, a robust knowledge of the NMM based on the microalloyed steel is not so well understood. Previously, this has been true because of limitations in experimental and diagnostic techniques with regard to relationship between strengthening mechanisms on each layer. Recently, new experimental and in-situ diagnostic techniques, coupled with advanced microstructure characterization techniques, are starting to allow for the detailed study of such phenomena and its linkage to microstructure. Moreover, these experimental advancements have been accompanied by the radical changes in analytical capabilities enabled by computers. Thus, the weight of large-scale computations has given an amazing predictive capability to the field and an ability to incorporate large data sets collected by modern experiments into mathematical models. Material model development - in general, and nanostructured multilayered – in particular, is largely dependent on continuum scale phenomena and ignores the rich multiscale physical and chemical phenomena that are responsible for the macro-scale plastic deformation response of a polycrystalline metal. The substantial complexity of these phenomena, which occur through the evolution of microstructure and texture in response to multilayered structure, presents formidable challenges to theoretical model development of plastic deformation. While the experimental community has continued to push forward to identify the deterministic links between materials processing, microstructure, and dynamic properties, the primary challenge for computer modeling has been a physics-based, rheological model for multiphase and alloyed metals under dynamic loading conditions. Such a model is exactly what is desirable for modern, high strength materials, whose properties are manipulated through the use of micro-alloying, strong grain refinement and partitioning of strength amongst multiple phases. The development of this type of model can be done only by utilization of multi-scale analysis. The main objective of this project is two-fold: (1) improve the knowledge of the strengthening mechanisms that operate in the NMM and (2) based on this improved knowledge, propose a microstructurally aware constitutive description between basic parameters of loading (stress state and strain rate) and mechanical behavior of representative, modern, NMM. Realization of the proposed project will manifest in a process-aware understanding of the influence of strain rate on changes in properties of finished product. In consequence it will be possible to design the new nanostructured multilayered materials with given sensitivity to strain rate, respecting the process parameters as well as the strengthening models.