The aim of the project is to develop a new autonomous smart material for effective reduction of mechanical vibrations. Currently available intelligent materials have significant disadvantages, which narrows their potential commercial applications. In most cases, the high weight of such solutions and necessity to attach complex additional systems limit their use, especially in the lightweight structures. In the proposal mechanical metamaterials with properties not found in nature should face these requirements. The unusual mechanical properties arise out of their geometric structures instead of the base material whereof they are made. The functionality of the proposed self-activating materials will be based on their programmed elastic instability. Properly designed geometric structure of the metamaterial allows the implementation of appropriate control strategies. Within the project it is planned to develop the geometric structure of two separate groups of metamaterials, which strategies for action and effectiveness have been previously investigated by the author of the proposal. Smart material for abatement vibrations caused by a moving load and the smart material forming the core of the sandwich structure will be extensively considered. Determination of dynamic properties of metamaterials will require the development of effective, fast and reliable numerical tools. The elastic deformation of the structure leads to rapid changes in geometry. Some parts of the deformed structure of the material start to be in contact with others. The research of dynamically changing zones of contact in the material will be indispensable. Prepared numerical platform will allow the development of the metamaterial structures with the atypical mechanical properties, unexplored so far. Structures will be produced in casting process. Recent achievements in the field of modern additive manufacturing processes enable to produce molds for prototype metamaterials. The effectiveness of metamaterials will be tested experimentally using a dedicated test stand, based on the modal shaker and high-speed camera. We assume that the proposed self activating materials exceed present solutions available on the market and at the same time will be affordable and easy in production. In the future computational environment developed within the project will allow to design mechanical properties of metamaterials on request, for specific applications. Smart lightweight metamaterials should be used in many modern industrial sectors, replacing traditional passive solutions, including aerospace and automotive.