Research program

MECHNICS OF INTELLIGENT MATERIALS AND COMPOSITE MATERIALS

Research and development of experimental and numerical methods for determination of complex thermomechanical properties of intelligent polymeric materials such as magnetorheological elastomers and plastomers (MREs and MRPs), shape memory polymers (SMPs) and polymeric foams (PFs). The behavior of these materials is controlled by external magnetic, electrical, light or heat fields. Development of material models based on description of internal structure and experimentally determined parameters. Mathematical modeling of complex thermomechanical properties of these materials. Numerical simulation of the response of these materials using the finite element method.

Research activities

EXPERIMENTAL RESEARCH ABOUT MECHANICS OF INTELLIGENT MATERIALS AND ITS THERMOMECHANICAL RESPONSE

- Preparation of experimental samples using both traditional composite manufacturing methods and modern materials synthesis methods such as 3D printing. Production of anisotropic MREs under external magnetic field.
- Research on geometry of internal macro and microstructure by using imaging methods.
- Development of innovative experimental methods and experimental devices for response determination of composite intelligent materials to static and dynamic loading under the influence of magnetic field. Application of modern non-contact optical methods for deformation measurement.
- Determination of time-dependent rheological behavior of studied materials, relaxation response and behavior under dynamic loading.
- Experimental determination of the response of intelligent materials to the load with simultaneous action of another external stimulus in the form of magnetic, electric or thermal field.
- Research of dissipated energy mechanism in structural materials due to material damping and shear friction of structural elements.

DETERMINATION OF MATERIAL PARAMETERS AND CONSTITUTIVE RELATIONS

- Determination of material parameters and models based on experimentally obtained data.
- Creation of constitutive relations needed for numerical modeling of material response.
- Modeling of mechanical behavior of materials and their dependence on external forces and physical fields.

NUMERIC RESPONSE SIMULATIONS VIA FINAL ELEMENT METHOD

- Implementation and application of constitutive relationships in FEM software and simulation of the behavior of simple structures made of intelligent materials taking into account the coupling and interaction between the acting physical fields (force, magnetoelectric, thermal, etc.) and depending on boundary conditions.
- Verification of FEM simulation results and experimentally determined behavior using test methods and tests.