Additive manufacturing, commonly referred as 3D printing, has become very popular in recent years, both in industry and academia. The basis for such wide-spread interest is undeniable advantage of fast prototyping, even for complex structures, also for advanced materials. Materials as well as fabrication approches can be used for clasification of additive manufacturing. We can produce polymers (plastics), metals, and ceramics. Also, composites (mixtures of different materials) are getting attention. Usually, this approach leads to complex problems as different materials tend to behave differently when exposed to physical and chemical processes.

As an example, a typical proces of composite manufacturing can be discribed as below: (1) mixing metallic and ceramic powders (2) spreading of one layer of such mixture (3) applying a lot of heat to powders by scanning probe

As a results of scanning (3) the powders get more plastic and even melt, and eventually connect. This happens only where the scanning applied heat. A laser is usually a heat source. When the first layer of powders is done scanning, the second layer is added. This way the whole bulk of planned geometry is fabricated with appriоprate scanning strategy.

Such an approach creates several problems. Firstly, in step (1) the mixture composition is fixed. If we want to change it, we need to prepare a new mixture. Secondly, in step (2) the same mixture is used so the whole part is being built from the same material. As can be expected, it is not always essential and is usually economically unjustified, especially for expensive materials.

The solution for those problem is a proposed project, which basically offer conducting steps (1) and (2) for just one powder (cheaper) and eventually adding the second powder only in the spots where it is really needed from technical viewpoint. As an example where such an approch would be beneficial, we can discuss friction pair. In typical tribological pair, the wear occur only at small surface compared to the whole bulk. It means that reinforced mechanical properties are needed in relatively small fraction of part’s volume. With usual additive manufacturing strategy, the whole volume would be made of the composite. In proposed project, we want to manufacture parts, where reinforcement is added only in prescribed spots of parts, i.e. where actual wear is expected.

The aim of the project is additive manufacturing of composite parts with precise control of reinforcement distribution. This aim will be achieved by 3D printer with dedicated module for precise reinforcement application.

The planned research consists of initial numerical modeling of composites with complex particles distribution, material characterization and mechanical testing. Models will be used to predict an optimal reinforcement distribution and enhance project of its application. Also, engineering work on printer and distribution module will be carried out.

As a results, a device for 3D printing of composites with complex reinforcement distribuition will be manufactured. Knowledge and skills for optimal composite fabrication will be acquired, especially for mechanical and tribological applications.