The Origami BioBandage project has been created to fight against osteoporosis, which is nowadays a serious problem affecting whole society. The project is an innovative research describing bioimplant consisting of polymer nanomaterial, which is made of randomly placed nanofibers, covered with stem cells from Wharton's jelly. Nanofibers have been enriched by the hydroxyapatite nanoparticles for the purpose of application in bone tissue regeneration (especially of the osteoporosis patients). What is important, our experiments were complemented by mathematical modelling and computer simulations, based on results from our biological experiments *in vitro,* like scanning electron microscopy and confocal fluorescent microscopy. It allowed us to describe the interactions between (1) stem cells and surface of the nanomaterial, (2) the patient's tissues and the bioimplant. Our idea is to apply such rolled bioimplant in place of comminuted capitulum, where it will unroll itself, then the stem cells will begin healing process and the nanomaterial will be decomposed within a few months.

After carrying out the *in vitro* experiment, we noticed that stem cells survived on the material surface. Our observation confirmed the fact that the mats are biocompatible and friendly for stem cells. The cells looked like fibroblasts, this result demonstrates their good condition and their willingness to make further divisions. We found also a presence of extracellular matrix, which was generated by stem cells on the surface. Probably, it was cells answer for material's nanoarchitecture. The cells were producing adhezion proteins in matrix, which helped them to stay on the surface.

Our first mathematical model proved correctness of our own "cell origami" method, using cell traction forces resulting from interactions between stem cells, extracellular matrix and material surface, to fold the material. The second simulation considers all interactions between cells covering the mat. We have also prepared tools for automatic detection of boundary conditions derived from medical imaging, not only presenting the bioimplant, but also cells in patient's fractured bone. Our final idea is to describe interactions between stem cells and patient's cells, especially the flow of right collagen, which is a clue in the osteoporosis disease. Then, in the future we will be able to prepare individual biobandage for each patient.