# VATERITE $CaCO_3$-COATED POLYMERIC FIBROUS SCAFFOLDS FOR BIOMEDICAL APPLICATIONS

**MARIIA SAVELEVA[1,3]*, ALEXEY IVANOV[2], TIMOTHY E. L. DOUGLAS[4], DMITRY GORIN[3], ANDRE SKIRTACH[1], BOGDAN PARAKHONSKIY[1]**

[1] DEPARTMENT OF MOLECULAR BIOTECHNOLOGY, GHENT UNIVERSITY, BELGIUM
[2] RESEARCH INSTITUTE OF TRAUMATOLOGY, ORTHOPAEDICS AND NEUROSURGERY, SARATOV STATE MEDICAL UNIVERSITY, CHERNYSHEVSKY, RUSSIA
[3] EDUCATIONAL RESEARCH INSTITUTE OF NANOSTRUCTURES AND BIOSYSTEMS, SARATOV STATE UNIVERSITY, RUSSIA
[4] MATERIALS SCIENCE INSTITUTE, LANCASTER UNIVERSITY, UK
*E-MAIL: MARIIA.SAVELEVA@UGENT.BE

***[ENGINEERING OF BIOMATERIALS 143 (2017) 76]***

## Introduction

The designing of new hybrid biomedical materials based on combination of organic and inorganic components is promising candidate for application in regenerative medicine. Recent development in materials science and bioengineering offers opportunities to design smart scaffolds, which are capable to imitate living tissues and stimulate formation new native tissues [2]. Functionalization of polymeric scaffolds is a promising approach to achieve biomimetic and bioactive properties. In this research, we have developed novel composite scaffolds based on polymeric polycaprolactone fibers coated with porous calcium carbonate structures (PCL/$CaCO_3$) for tissue engineering and have shown their drug delivery and release in rats.

## Materials and Methods

To obtain PCL/$CaCO_3$ scaffolds, the electrospun PCL matrix was produced in the first step by using an electrospinning technique. The mineralization of the PCL matrix was carried out by using method introduced previously [2]. In vivo experiments, white nonlinear male rats were used. The scaffolds were subcutaneously implanted in the interscapular area of rats. After 21 days of implantation, the scaffolds were explanted. Initial and explanted scaffolds were examined by histological studies, scanning electron microscopy and X-ray diffraction.

## Results and Discussion

The schematics and real imaging of obtained PCL/$CaCO_3$ scaffolds can be seen in FIG. 1. The route of PCL electrospun scaffold mineralization is shown by the scheme. As it can be seen, microfibrous matrix of the PCL/$CaCO_3$ scaffold is covered with the porous particle-like $CaCO_3$. These porous spherical $CaCO_3$ microparticles called vaterite proved their potential for biomedical applications including bone regeneration and drug delivery [3,4]. Therefore, modification of PCL matrix with vaterite coatings could significantly improve osteoconductive and bioactive properties of polymeric scaffold.

To study biocompatible and implantable properties of PCL/$CaCO_3$ scaffolds, in vivo tests were carried out with rats. The results of histological study demonstrated capability of PCL/$CaCO_3$ scaffold to be colonized by fibroblastic elements and vascularized without promoting inflammatory response in surrounding tissues in the course of subcutaneous implantation tests in white rats that proved its biocompatibility.

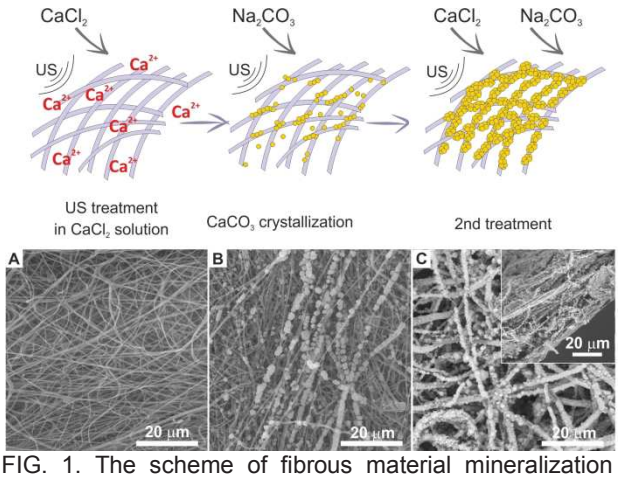


FIG. 1. The scheme of fibrous material mineralization under ultrasound treatment and corresponding SEM images of blank PCL fibrous material (A), PCL material on initial mineralization stage (B), and scaffold with uniform $CaCO_3$ coating after second treatment and cross-section of this scaffold (C) [2].

## Conclusions

In this work, we have designed new PCL/$CaCO_3$ scaffolds, which were found to demonstrate a high degree of biocompatibility in vivo.

## Acknowledgments

The ERA-NET Rus Plus program is acknowledged for support in the framework of the project “Fabrication and investigation of new hybrid scaffolds with the controlled porous hierarchy for bone tissue engineering” (Intelbiocomp). B.P. thanks Research Foundation Flanders (FWO), Belgium, for a postdoctoral fellowship.

## References

[1] T. Dvir, et al., Nat. Nanotechnol. 6 (2011) 13–22.
[2] M.S. Savelyeva, et al., J. Biomed. Mater. Res. Part A. 105 (2017) 94–103.
[3] H. Maeda, et al., J. Mater. Sci. Mater. Med. 18 (2007) 2269–2273.
[4] B. V. Parakhonskiy, et al. ChemPhysChem. 15 (2014) 2817–2822.