Novel Bioglass Incorporated PCL/Gelatin Electrospun Scaffold for Accelerated Wound Healing

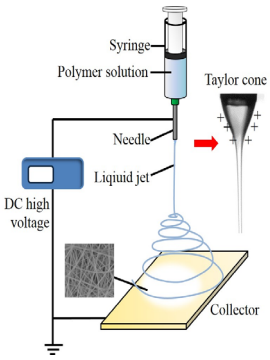
Pushkar Tatiya, Amit Biswas

Department of Biotechnology and Medical Engineering
National Institute of Technology, Rourkela

BioTERM 2019 — Innovation to Translation

INTRODUCTION

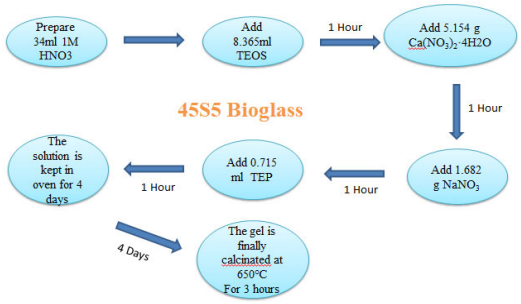
- Electrospinning is an efficient technique for the fabrication of polymer nanofibers.
- Electrospun fibers have high surface area to volume ratio and higher porosity.
- Nanofibers are fabricated from a number of materials like natural polymers and synthetic polymers.
- Synthetic polymers used are PCL, PVA, PEO, PEVA, Polyurethane, etc.
- Natural polymers used are collagen, Silk fibroin, chitosan, cellulose, starch, Fibrinogen, gelatin, etc.
- Gelatin is chosen for this research work because of its high resemblance with collagen which is present in the extra-cellular matrix.
- Poly-caprolactone is blended with gelatin to enhance the mechanical strength and for ease of electrospinning.
- 45S5 bioglass can accelerate skin regeneration by enhancing angiogenesis and collagen deposition in the proliferation stage of the wound healing process.



- BG ionic products activates macrophages to express more anti-inflammatory and angiogenic growth factors.

METHODOLOGY

❖ Synthesis of 45S5 bioglass (Sol-gel method)



❖ Electrospinning parameters of bioglass incorporated PCL/Gelatin scaffold

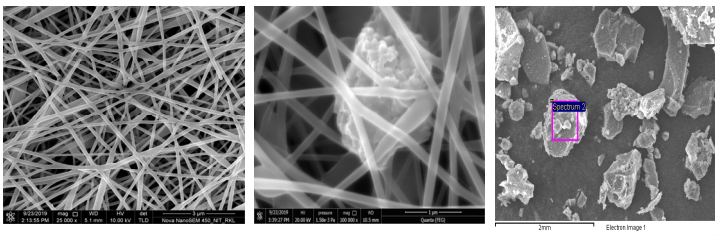
- The PCL/Gelatin polymer blend was prepared in TFE.
- The polymer was then electrospun at various voltages from 10kV to 15kV.
- Beads were formed at high voltage(15kV).
- Nanofibers without beads were obtained at 12kV.
- To improve the bioactivity and antimicrobial property of the scaffold, Ag doped bioglass at a concentration of 10% and 15% of the polymer weight was added to the polymer blend and then electrospun.

1.	Concentration of : PCL Gelatin Bioglass	12% 12% 10% of polymer
2.	Final Polymer solution ratio (PCL/Gelatin)	50/50
3.	Voltage applied	12kV
4.	Tip to collector distance	10 cm
5.	Flow rate	1.2 ml/hr
6.	Drum rotation speed	1200 rpm

RESULTS

1. Morphology of nanofibers and bioglass

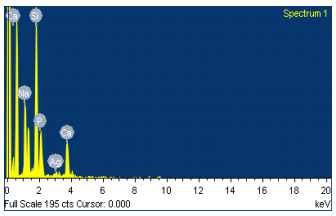
PCL/GE NANOFIBERS | AgBg-PCL/GE NANOFIBERS | Ag doped 45S5 BIOGLASS



- The morphology of the nanofibers was analysed using environmental scanning electron microscope
- Uniform non beaded nanofibers were fabricated.
- The average diameter of the nanofibers was found to be **204nm** using ImageJ software.

2. SEM EDX of silver doped 45S5 bioglass

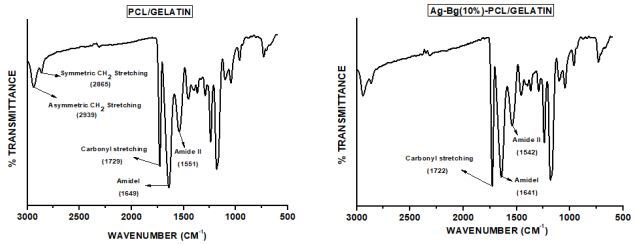
SEM EDX Ag-BG 45S5



ELEMENTAL COMPOSITION

Element	Weight%	Atomic%
Na K	19.09	24.94
Si K	42.84	45.80
P K	13.62	13.20
Ca K	19.63	14.71
Ag L	4.83	1.34
Totals	100.00	

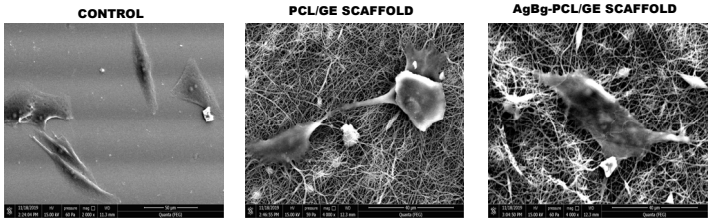
3. FTIR Spectra of PCL/Gelatin and bioglass incorporated scaffold



- PCL/GELATIN nanofibrous scaffold show characteristic peaks at 2939 (asymmetric CH2 stretching), 2865 (symmetric CH2 stretching), 1729 (carbonyl stretching), 1649 (amide I), 1551 (amide II).

4. In-vitro cell study

CONTROL | PCL/GE SCAFFOLD | AgBg-PCL/GE SCAFFOLD



- MG-63 cells were seeded on the scaffold and incubated for 24 hours.
- The cells were then fixed, sputter coated with platinum and analysed using eSEM.
- The images clearly show the natural morphology of the cells and also the biocompatibility of the scaffold.

CONCLUSION

- Silver doped 45S5 bioglass was synthesised and successfully incorporated in the PCL/Gelatin scaffold.
- FTIR spectra of the scaffold confirms the presence of both PCL and gelatin.
- MG-63 cells were cultured on the scaffold which shows its biocompatibility.
- The antimicrobial property of the scaffold needs to be assessed.
- Further cell study using human dermal fibroblast and keratinocytes needs to be done.

REFERENCES

- I. Laidmäe, K. Ērglis, A. Cēbers, P. A. Janmey, and R. Uibo, "Salmon fibrinogen and chitosan scaffold for tissue engineering: in vitro and in vivo evaluation," *J. Mater. Sci. Mater. Med.*, 2018.
- A. Sadeghi, M. Pezeshki-Modaress, and M. Zandi, "Electrospun polyvinyl alcohol/gelatin/chondroitin sulfate nanofibrous scaffold: Fabrication and in vitro evaluation," *Int. J. Biol. Macromol.*, 2018.
- K. Vig *et al.*, "Advances in skin regeneration using tissue engineering," *International Journal of Molecular Sciences*. 2017.
- A. Haider, S. Haider, and I. K. Kang, "A comprehensive review summarizing the effect of electrospinning parameters and potential applications of nanofibers in biomedical and biotechnology," *Arabian Journal of Chemistry*. 2018.