

## **NDnano Undergraduate Research Fellowship (NURF) 2012 Project Summary**

1) Student name: Gary Blackburn

2) Faculty mentor name: Abhijit Biswas

3) Project title: Nanoscale bioengineering of bone-inspired, all-natural bionanocomposite scaffolds for bone substitutes and tissue regeneration

4) Briefly describe any new skills you acquired during your summer research:

I learned a huge amount this summer under the supervision of Professor Biswas. I think the most notable improvement in my skill set has been my ability to report on scientific findings.

Throughout our time on the research program we were assigned papers and articles to write. We were taught the importance of reporting findings quickly after the completion of an experiment. Details are quickly lost over time and when we report immediately we produce a much more comprehensive account of the happenings in an experiment. This is very important as it leaves a complete record that can be referred to at any point in the future.

5) Please briefly share a practical application/end use of your research:

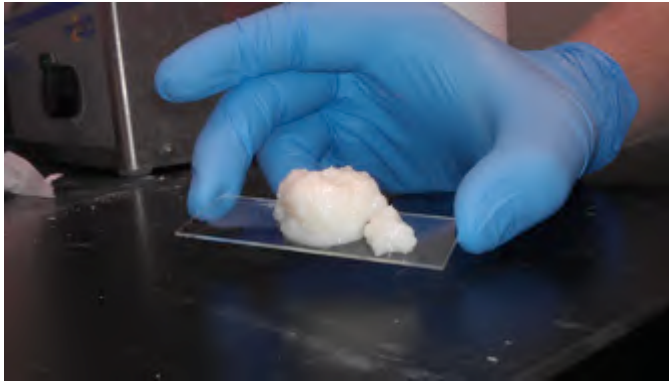
Our research has a hugely practical aspect to it. My principle concentration for the summer was using bionanomaterials for bone tumor engineering. Cancer is an affliction that traverses all classes and races and improving the treatment options available is vital in the progression of healthcare the world over. We created bioscaffolds that ultimately we hope could be implanted in bones to encourage healthy cell growth after cancerous bone tissues have been removed. We also strive to provide a scaffold which anti-cancer drugs can attach themselves to. This would mean our bone scaffold would help healthy bone cells proliferate while destroying cancerous cells upon post-operative implantation. The goal of this is to reduce recovery time for patients as well as reducing the risk of relapse. We have sent samples to laboratories in Italy and Little Rock for trials to investigate the efficacy of our bioscaffolds and anticipate results in the coming weeks.

Project summary:

Recent advances in nanotechnology have contributed to the development of multifunctional bionanomaterials that can target a bone tumor and deliver therapeutic drugs or genes.

Bionanomaterials based bone cancer treatment offers hope for treating bone cancer and provides many exciting possibilities to enable important new therapeutic outcomes. In this research we strived to address research questions at the level of fundamental biology and science to develop novel biomaterials and systems, particularly enabling cost-effective and large-scale production of multifunctional nanomaterial systems for the diagnosis and treatment of bone cancer.

The processes we followed to create the bioscaffolds spanned over several hours. A polymer matrix was created using benzyl-alcohol and polycaprolactone. Hydroxyapatite nanospheres were then added to this matrix. Calcium carbonate and chitosan powders were applied a number of times and the mixture was sonicated and mechanically stirred after each application. Once the required concentration of these compounds was achieved calcium and sodium based alginic powders were then included. Finally, collagen was added and the mixture was poured on to glass slides. See Fig. 1.



**Fig. 1. A sample of bioscaffold on a glass slide.**

These slides were heated using a hot plate in order to evaporate any benzyl-alcohol. See Fig. 2.



**Fig. 2. Samples being heated on a hot plate to evaporate benzyl-alcohol.**

These samples have since been sent to labs in Italy and Little Rock. The samples will have anticancer drugs attached them and their efficacy in destroying three different strains of cancer will be evaluated. Their ability to improve osteoblast proliferation will also be examined. We expect results from these trials in the coming months and will report on our findings.

Publications (papers/posters/presentations):

- VT&C Magazine, July 2012 – “Nanotech-Enabled Bone Tissue Engineering”
- VT&C Magazine, August 2012 - “Nanotech-Enabled Bone Tumor Engineering”
- “Solution Processable Polymer-Based Nanocomposite Coatings for Large-Area Carbon Capture and Conversion” – under review.
- “Advances in Bionanomaterials for Bone Tissue Engineering” – under review.
- “Bionanomaterials for Bone Tumor Engineering” – under review.