SMARTHIP™ Orthopedic Implantable Biosensor and Smart Drug Releasing

Yujia Wang¹, Frederick Zorbas², and Thomas J. Webster¹

¹ Department of Chemical Engineering, Northeastern University, Boston, Massachusetts, 02115, USA
² Nano Polymer Solutions, South Carolina, USA

Opportunity

SmartHip™, the most advanced in situ orthopedic implant biosensor and drug delivery system integrated bone health monitoring and drug releasing together, technically increased life period and prevented failure of bone implant.

- Integrated sensing and drug-delivering function to bone implant devices.
- Better osteoblast adhesion and biocompatibility at CNTs modified surface.
- Technically prevented failure of bone implants.

Approach

- Sensing Part: carbon nanotube and conductive polymer coated at the surface of anodized nanotubular Titanium. The specific Capacitance–voltage profiling of CNTs committed the sensing function.
- Responder part: chipset underneath the Ti substrate, collect sensing signal, stimulate polymer for drug release, communicate with transponder part.
- Processor part: integrated into an out-body device and uploads the implant data to doctor client for analysis, receiving prescription from doctor, control the chipset inner-body to release the drug on-demand.

Data or Results

Cyclic voltammograms with an electrolyte solution of 10 mM K3Fe(CN)6 in 1 M KNO3 for (a) plain Ti, (b) anodized Ti, (c) MWCNT–Ti, (d) the capacitance of all the electrodes in comparison.

Cyclic voltammogram proves the CNT modified anodized Ti transitioned into a Sensor.

Staphylococcus epidermidis Adhesion after 1 Hour without drug lease;
Even without sensing or releasing drugs, bacteria do not like our sensor

Impact

- Our technology added the biosensor and drug releasing platform feature to orthopedic implant devices, technically increased device life period and prevented failure of bone implant.
- Test results shown an ability to detect infection, inflammation, and bone growth earlier than what can be achieved today using conventional diagnostic tools.
- The sensor was able to promote higher alkaline phosphatase activity and calcium deposition next to the implant than currently used non-sensor based orthopedic implants.
- The sensor was also capable of releasing penicillin/streptomycin and dexamethasone on-demand to kill bacteria and inflammatory cells, respectively.

References and Acknowledgements:

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