

A NOVEL NANOAGENT FOR THE 3D VISUALISATION OF BONE MICRODAMAGE

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INTRODUCTION: The accumulation of fatigue-induced microdamage can often result in an overall thinning and weakening of the bone's structure through a reduction in its mass, which increases its fragility and makes an individual more susceptible to fractures. This microdamage cannot be detected by current clinical imaging techniques, such as X-ray computed tomography (CT), or MRI. In the research setting light microscopy techniques are restricted by interference from other biological matter and light scattering from the specimen. Lanthanide-based surfacemodified gold nanoparticles (AuNP-Ln) are biocompatible calcium(II) binding luminescent sensors that can be visualised with two photon microscopy and MRI.

METHODS: We present the study of europium [Eu(III)]-emitting surfacemodified gold nanoparticles as contrast agents for imaging microdamaged bone structure at low concentrations. These nanoparticles can be visualised using two photon microscopy to generate three-dimensional data of microcracks formed within bone.

RESULTS: Using two-photon excitation fluorescence microscopy, we were able to visualize and understand the manner in which these nanoagents bind to damaged bone, as well as demonstrate their selectivity toward exposed Calcium(II) within microcracks [1,2].

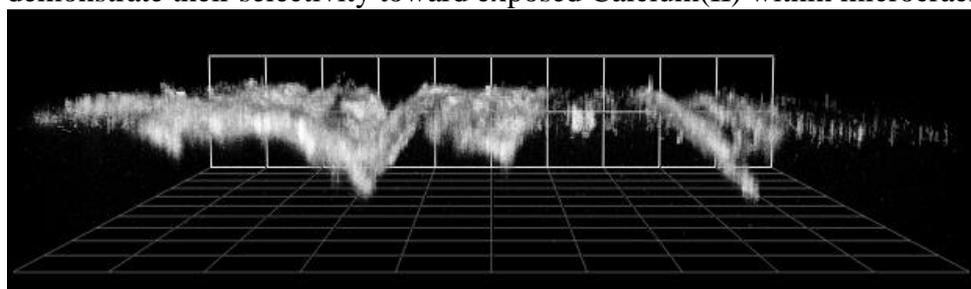


Figure 1: An example of a three dimensional image showing the nanoagent bound to bone microcracks.

CONCLUSION: The ability to use such nanoagents to Quantify and characterize the nature of this microdamage highlights the significance of this study and the step forward being made within bone diagnostics. Such in-depth analysis of microcrack formation has not been previously achieved in this manner and the unique structure of the nanoagent has the potential to be utilized alongside MRI and CT imaging as the technology is further developed.

- [1] Surender, E. M., Comby, S., Martyn, S., Cavanagh, B., Lee, T. C., Brougham, D. F. and Gunnlaugsson, T. "Cyclen lanthanide-based micellar structures for application as luminescent [Eu(iii)] and magnetic [Gd(iii)] resonance imaging (MRI) contrast agents." *Chemical Communications* **52**(72): 10858-10861 (2016)
[2] Surender, Esther M., Comby, S., Cavanagh, B. L., Brennan, O., Lee, T. C. and Gunnlaugsson, T. "Two-Photon Luminescent Bone Imaging Using Europium Nanoagents." *Chem* **1**(3): 438-455 (2016)