

4. Discussion

The cell encapsulation process showed that it was possible to effectively coat cells in PLL. The images of the coating, obtained by fluorescence microscopy, revealed a decrease of the coated cell diameter with an increase in PLL concentration during the coating process. This phenomenon could be attributed to an initial cytotoxic effect caused by the high polymer concentration and coating thickness. This increase could then be preventing the two way permeation of vital metabolic chemicals such as nutrients and waste. The pre-print contents of the bio-ink cartridges showed a significant difference between coated and non-coated cells, with non-coated showing significant flocculation. As flocculants were not visible during bio ink formulation it is believed that aggregation occurred in the 15min from formulation in the cell culture facility to arrival at the printing laboratory. Conversely, the coated cells showed good distribution through the drop and no evidence of flocculation. Uncoated cells were shown to block the orifice and stop printing after 10mins. The orifice blockage showed that a non-coated cell suspension would be unsuitable for prolonged printing. Conversely the coated cells showed a regular deposition of approximately 1 in 25 drops leading to the deposition of a cell. Although the cytotoxicity of the coating was not measured in this work, it is apparent that the U-2 OS cells coated in the lower concentration PLL survived, broke free and went on to proliferate after 7 days.

5. Conclusion

- It is possible to coat cells in a Cationic Polymer for use as an electrostatic stabiliser in bio-inks.
- Cells coated in a concentration of 200 µg/ml PLL will break free and proliferate after 7 days.
- The stability of bio-ink cell dispersions can be greatly enhanced by the use of an electrostatic stabiliser, and will ultimately aid predictable printing.

6. References

- [1] Kim G, Lee H, Kim Y, Kim S. Mineralized biomimetic collagen/alginate/silica composite scaffolds fabricated by a low-temperature bio-plotting process for hard tissue regeneration: fabrication, characterisation and in vitro cellular activities. *J. Mater. Chem. B* 2014;2; 5785-5798
- [2] Derby. B, Inkjet Printing of Functional and Structural Materials: Fluid Property Requirements, Feature Stability, and Resolution. *Annu. Rev. Mater. Res.* 40:395-414
- [3] Einstein A. Investigations on the Theory of, the Brownian Movement. Princeton University Press. 1989. Retrieved 10-06-2014 http://users.physik.fu-berlin.de/~kleinert/files/eins_brownian.pdf
- [4] A.Diaspro et al Single living cell encapsulation in nano-organized polyelectrolyte shells. *Langmuir* 2002;18;5047-5050
- [5] J.Kang et al (2012), Strong Response of Multilayer Polyelectrolyte Films to Cationic Surfactants. *Langmuir* 2012;28; 16751-16760