Functional Materials Course report
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Poly-N-isopropylacrylamide (pNIPAAm) is a hydrogel that is a thermo-responsive polymer that used used for tissue regeneration studies as well as in gels, microgels, for biosensors, and for drug delivery systems in vivo. This polymer has a lower critical solution temperature (LCST) of 32*C; above this temperature the polymer becomes hydrophobic and enters a collapsed state and below this LCST, the polymer becomes hydrophilic and enters a swollen state (Akintewe, n.d.). pNIPAAM has the ability to form a three-dimensional cross-linked lattice. The more cross-linking in the polymer, the more porous the polymer becomes, opening more channels in the polymer for water diffusion to occur, therefore increasing the rate of swelling at the LCST (Zhang, 2003).

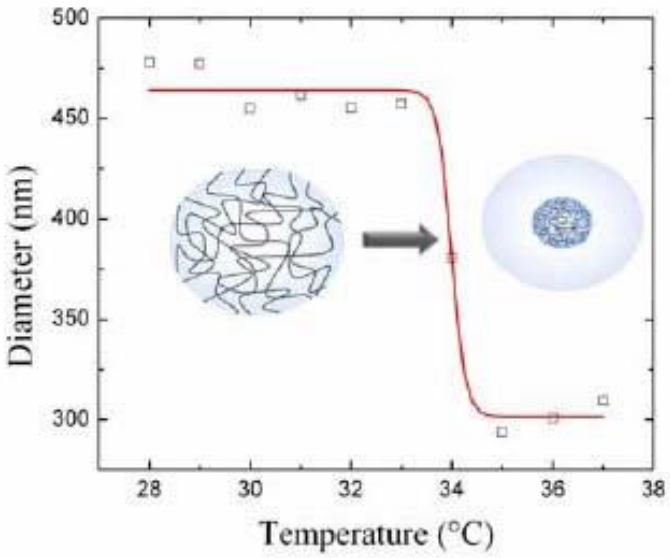

Figure 1. Change in size of PNIPAM nanoparticles due to temperature induced phase change. Brett W. Garner, Tong Cai, Zhibing Hu, Arup Neogi, Opt. Express 16, 19410-19418 (2008).

Copolymerization can occur when other substances are added to pNIPAAm, which can then lower the LCST of this polymer, bringing its LCST closer to the temperature of the human body, making this a particularly useful polymer in the human body for delivery of drugs or slow release of molecules (Wikipedia, 2014).

Using pNIPAAm for cell printing is a current area of research that is being investigated at The University of South Florida, particularly for the use of tissue regeneration. Using

a silicone wafer with a microbeam pattern consisting of microbeams between 50-100 µm in width and 25 µm in height, silicone elastomer (PDMS) molds are created in order to fabricate pNIPAAM with a desired pattern of microbeams. Glass coverslips are used as the surface for the pNIPAAM surface and are first treated with a TPM (3-(trichlorosilyl) propyl methacrylate) to increased the adhesion of the pNIPAAM to the glass coverslip. A solution of NIPAAm is micropipetted onto the PDMS molds and polymerized under ultraviolet light at 350 nm for 4 minutes. Mouse fibroblast cells are being seeded onto this polymer and using its unique property of swelling at 32*C, the cells that are seeded onto the pNIPAAm are released from the polymer when swelling occurs. This is showing to be an improved technique for cell release because when the cells are released, there is limited shear stress on the cells, keeping the composition of the ECM largely intact (Akintewe, n.d.).

References

Akintewe, Olukemi, Samuel Dupont, Kranthi Elineni, Michael Cross, Ryan Toomey, and Nathan Gallant. "Shape-Changing Biomaterials: Surface Expansion Triggers Rapid Release of Patterned Tissue Modules." The University of South Florida, unpublished work.

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Zhang, Xian-Zheng, Da-Qing Wu, and Chih-Chang Chu. "Effect of the Crosslinking Level on the Properties of Temperature-sensitive Poly(N-isopropylacrylamide) Hydrogels." Journal of Polymer Science 41.6 (2003): 582-93. Web. 07 July 2014.