# THERMORESPONSIVE, pH AND REDOX-SENSITIVE POLYMER CAPSULES AS DRUG CARRIERS

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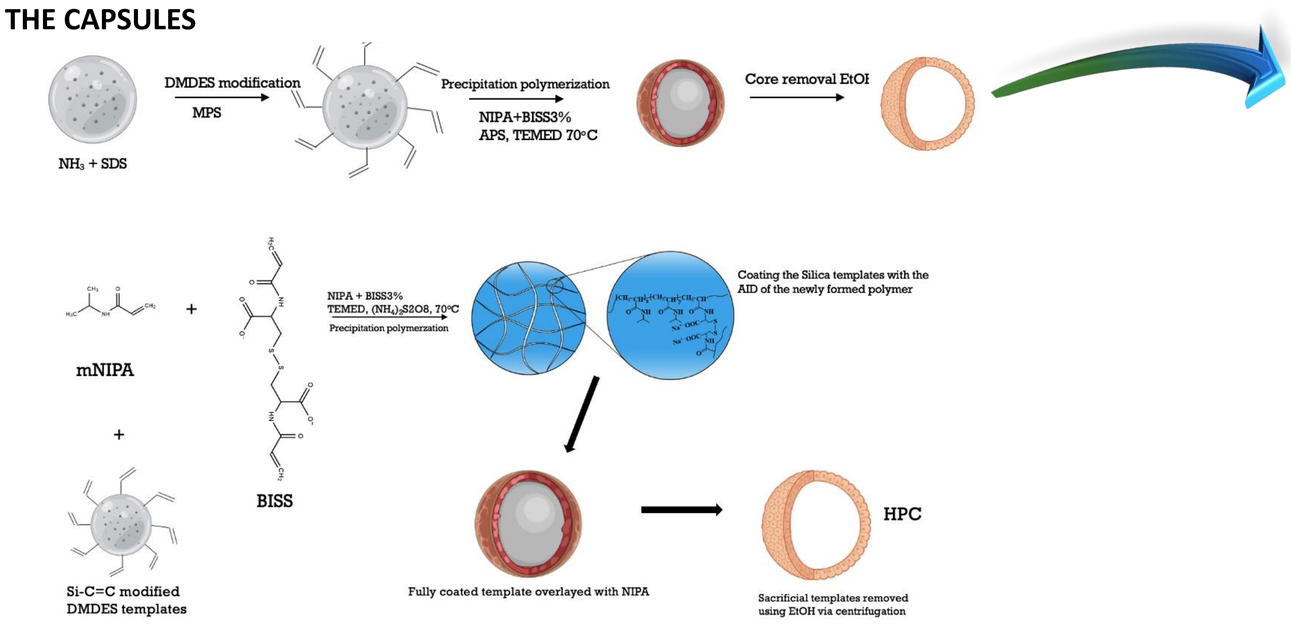
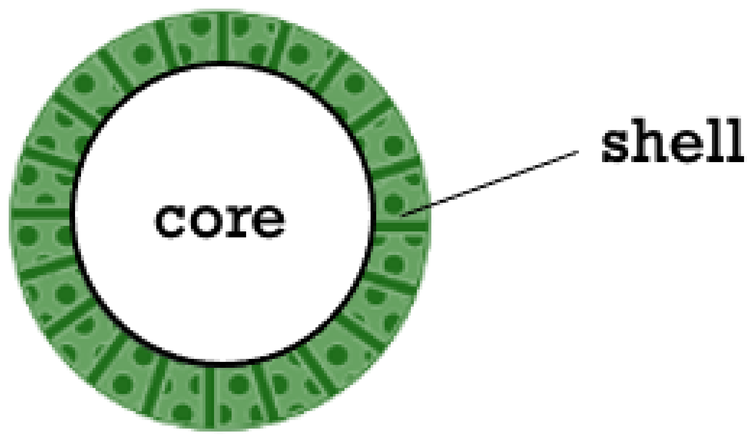
**Polymer based capsules are primarily composed of a shell and core. Hydrogels are the components of the shell whereas the core is usually a hollow-empty-core. For hydrogels to form a well connected network, the chains must be crosslinked and that is where a cross-linking agent comes in. Just like in microgels, capsules undergo a rapid volume phase transition in response to external stimuli (such as change in temperature, pH, and ionic strength). This stimuli responsiveness made it possible to utilize the polymer capsules in controlled and regulated drug release. Furthermore, the crosslinking agent is based on a diacryloyl derivative, (BISS) consisting of a disulfide bond and charged carboxyl groups. With this chemical groups, redox degradation and ionic responses are possible. The objective of our work is to design a hollow polymer capsule, HPC, that degrades in the presence of glutathione (a compound present in cancer cells at a relatively higher concentration), and responds to pH and temperature changes. With these properties, controlled release of drug to cancer cells will be possible thereby promoting a more efficient treatment of cancer.**

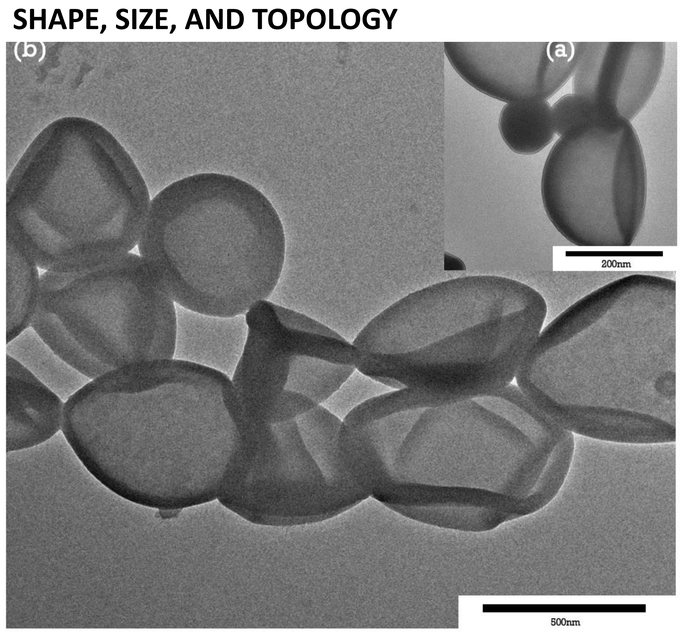
## *Synthesis and characterization of poly(NIPA-BISS) Hollow Polymer Capsules*

**SCHEME AND PROCESSES INVOLVED IN THE SYNTHETIC PREPARATION OF THE CAPSULES**

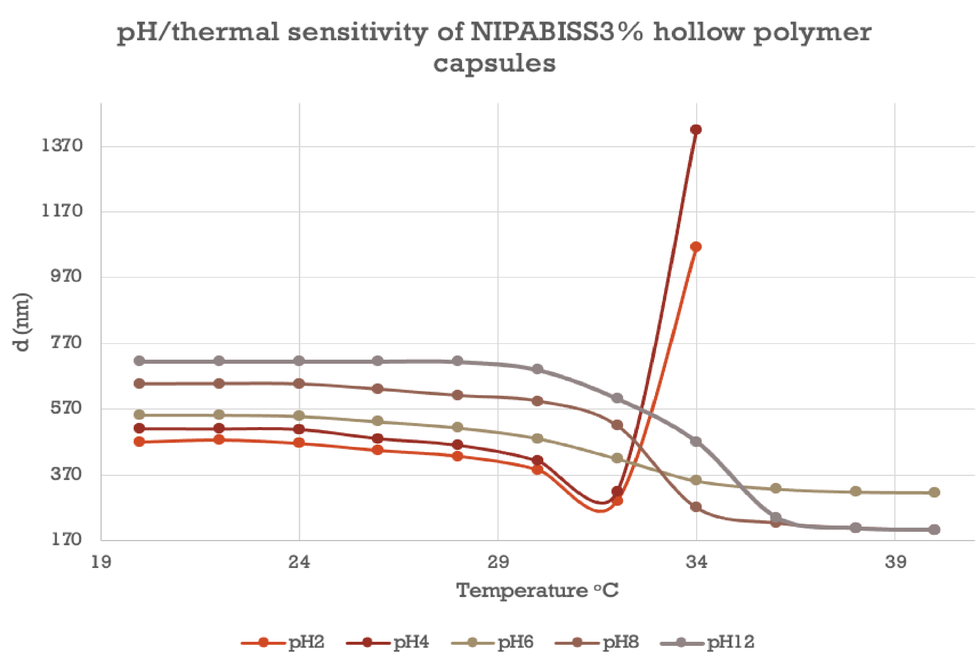



**PICTURES TAKEN UISNG A TRANSMISSION ELECTRON MICROSCOPE TO OBSERVE THE SHAPE, SIZE, AND TOPOLOGY**

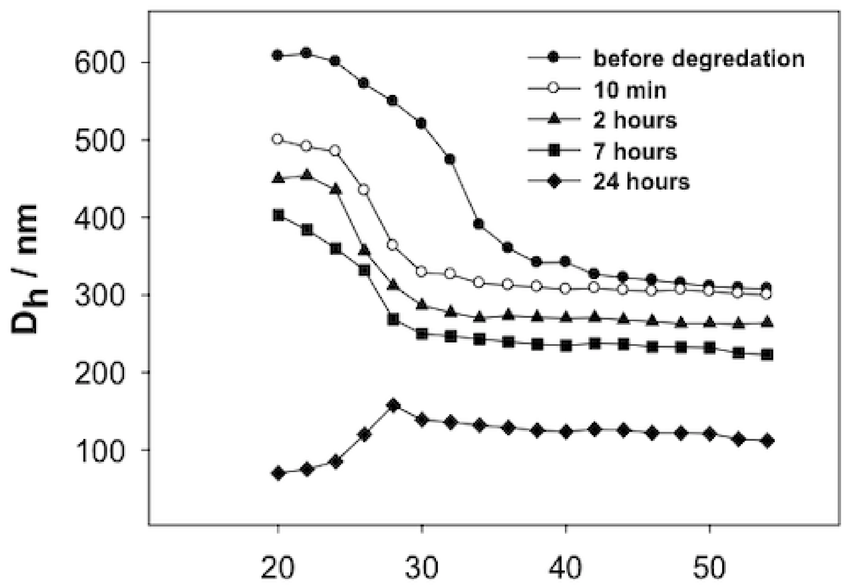


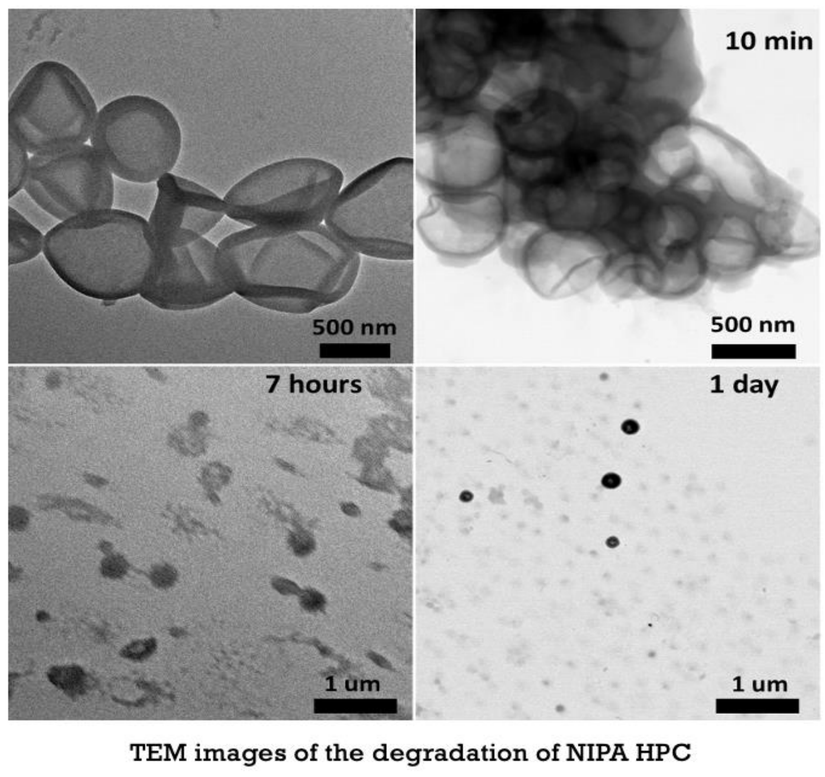

- TEM images of NIPA-BISS3% HPC
- (a) showing a higher magnification
- And (b) lower magnification
- Collapsed state after drying



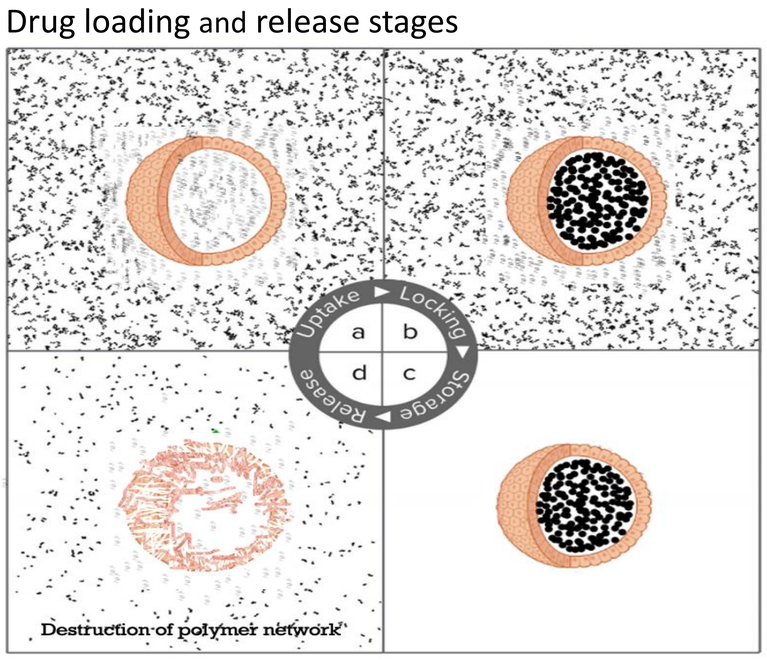

## *Degradation of poly(NIPA-BISS) capsules*

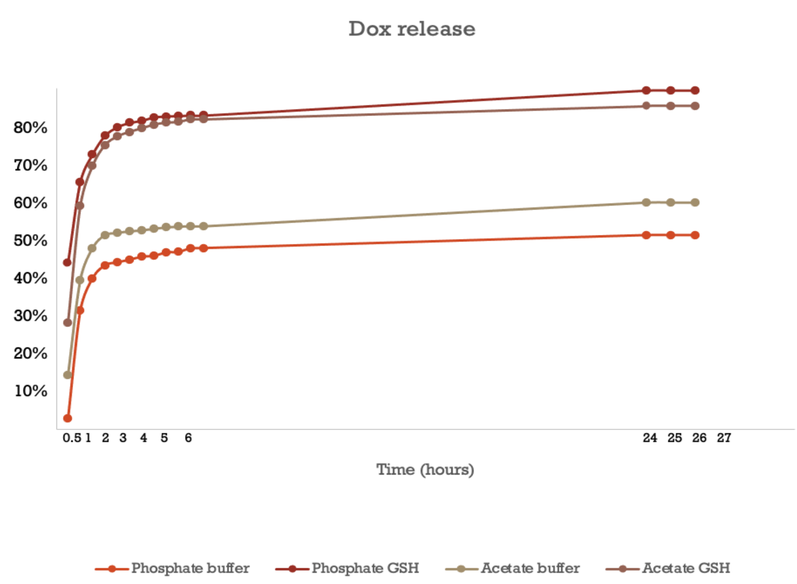
**CHANGING OF SWELLING BEHAVIOUR OF CAPSULES DURING TIME DEPENDENT DEGRADATION IN THE PRESENCE OF GLUTATHIONE**




Drug loading and release stages




**The biodegradable N-isopropylacrylamide crosslinked hollow polymer capsules, HPC, prepared using sacrificial silica-based templates, were subjected to degradation and drug test. We used glutathione, GSH, as the reducing agent. GSH redox degradation of the polymer was efficient favored by the S-S linkage. To examine the release of drug in cancer environment, four invitro systems were prepared. The systems contained acetate buffer, phosphate buffer, acetate buffer with 40nM GSH, and phosphate buffer with 40nM GSH. The result showed over 80% release in the presence of GSH whereas in the absence of GSH, release was about 50%. Also, the acidic level of the buffer played a role in the drug release where acetate buffer observed a higher drug release. It is also important to note that the microgels are stable under physiological conditions and a wide range of parameters between pH 6 – 12 and temperature 0 – 60° C. Hence, it will be evident to say that the HPC cross-linked with bisacryloyl cystine is an interesting chemical construct and a suitable drug delivery systems.**