Characterization of Linear Poly(*N*-Isopropyl Acrylamide – Spiropyran – Acrylic Acid) Copolymer by DSC and UV-Vis spectroscopy

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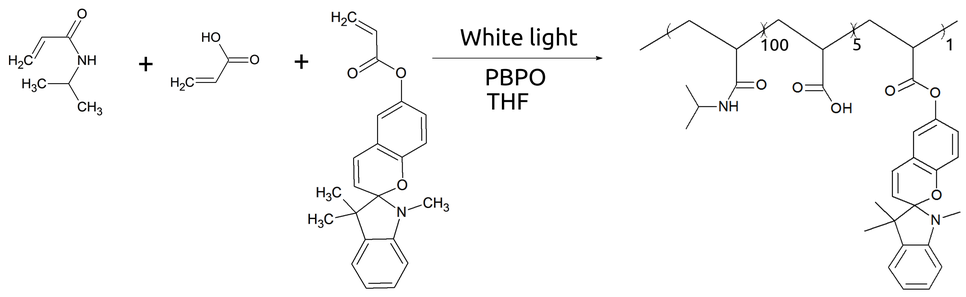
Insight

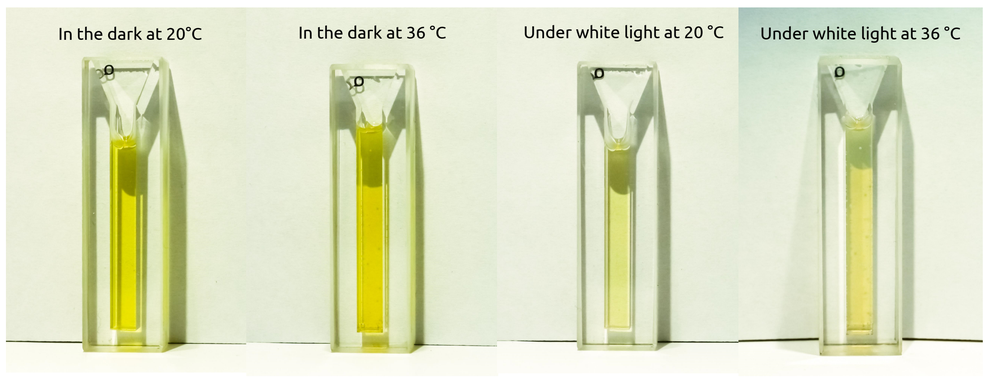
Introduction

The liquid critical solution temperature (LCST) of poly(*N*-isopropylacrylamide) (pNiPAAm) is a well documented process [1]. Because of this property pNiPAAm became a very attractive starting material for thermo-responsive polymers and the synthesis of hydrogels. Incorporation of other co-monomers in the pNiPAAm, such as photocromic units, has been shown to produce polymers that are both thermo- and photo- responsive [2.]. Our research focuses on synthesizing a linear poly(*N*-isopropyl acrylamide–spiropyran–acrylic acid) (pNiPAAm–SPA–AA) copolymer which can change its hydrophilicity either by white light irradiation or by temperature change.

Co-polymer synthesis:

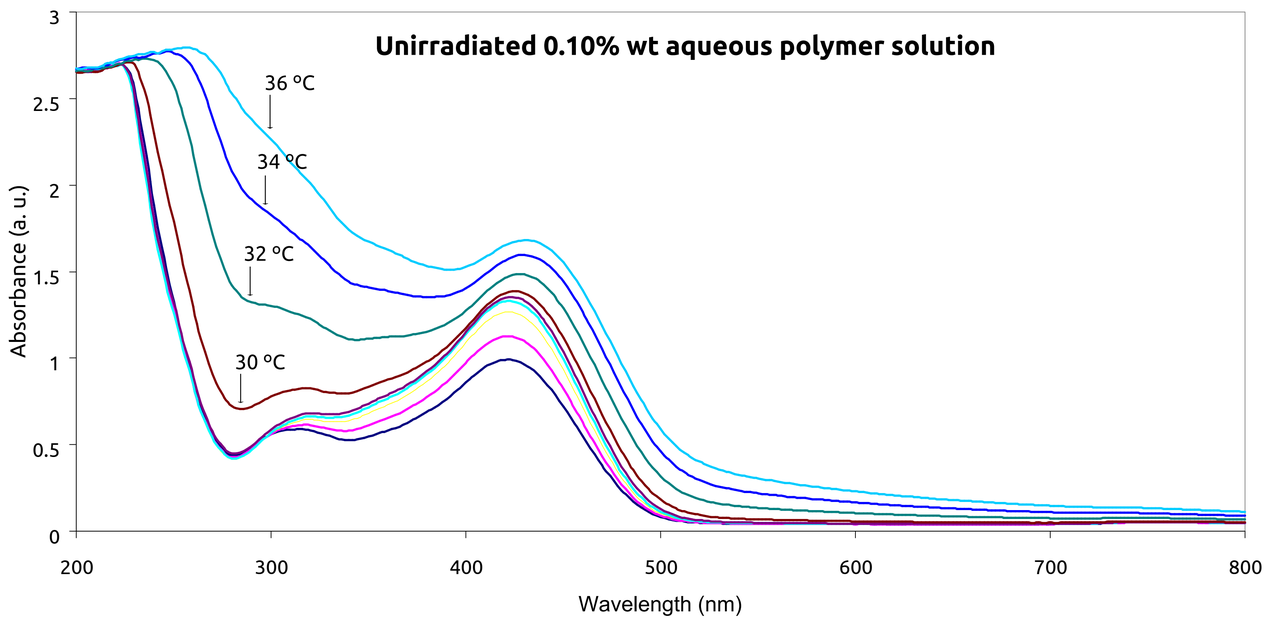


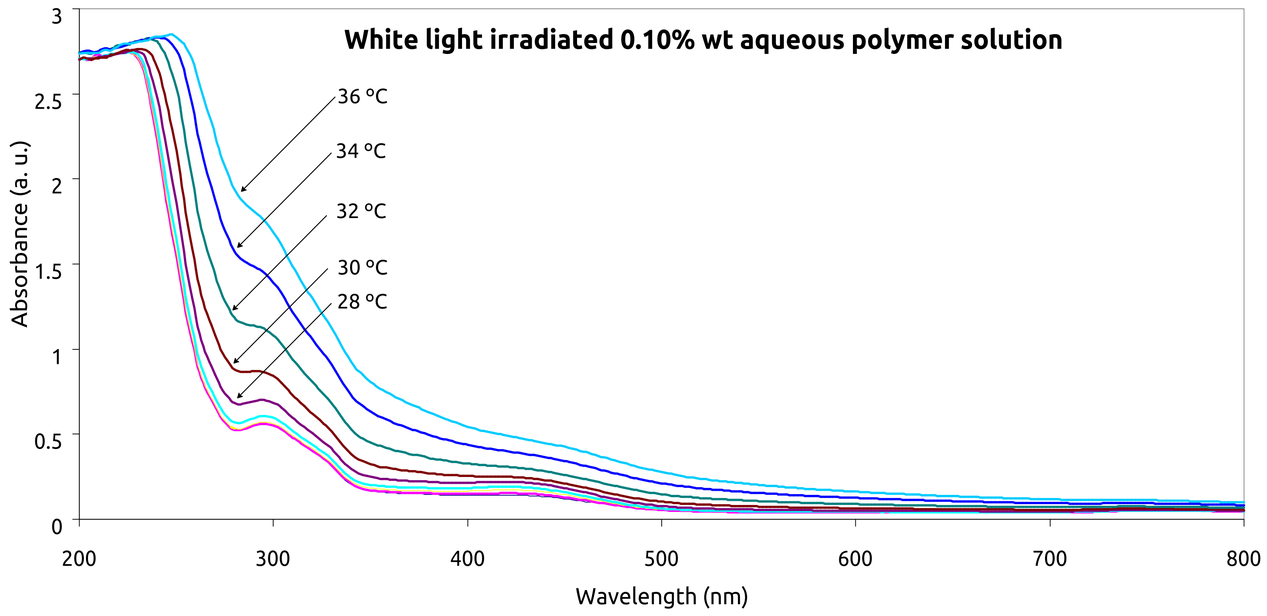
Aqueous Polymer Solution



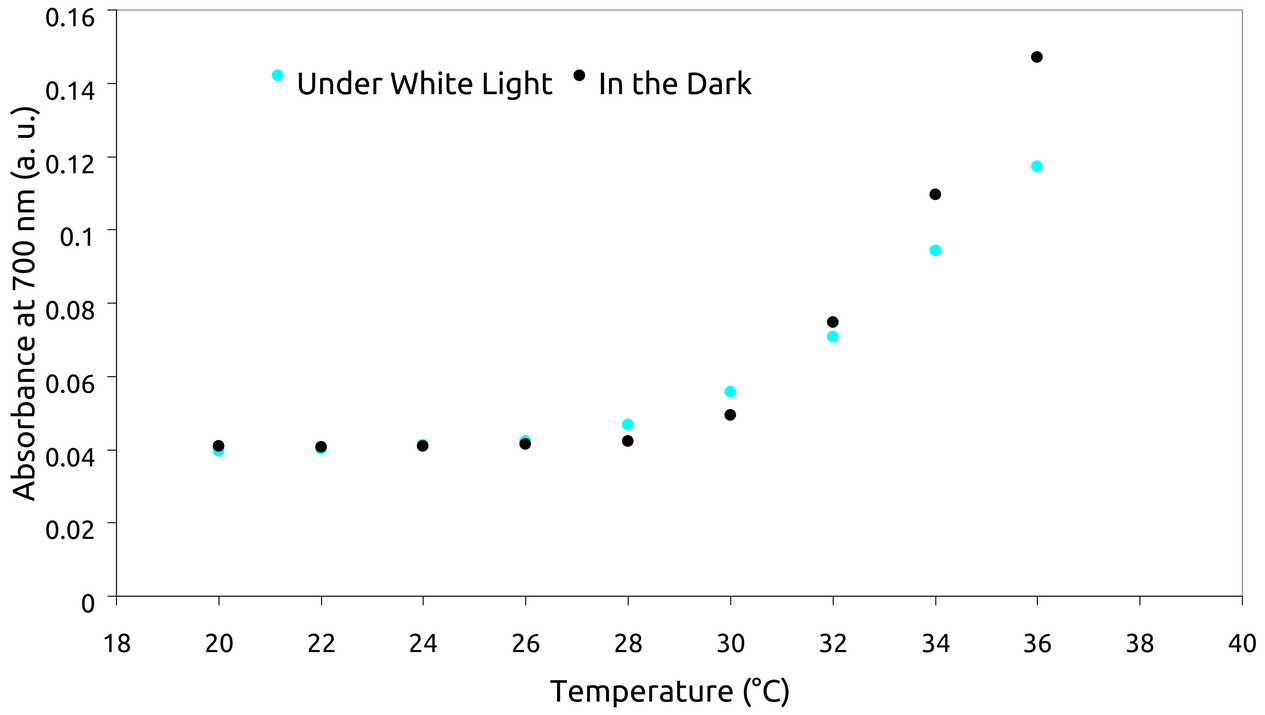
These photos show a 0.10% aqueous solution of the polymer under different temperature and lighting conditions.

The influence of temperature on the optical properties of the polymer solution



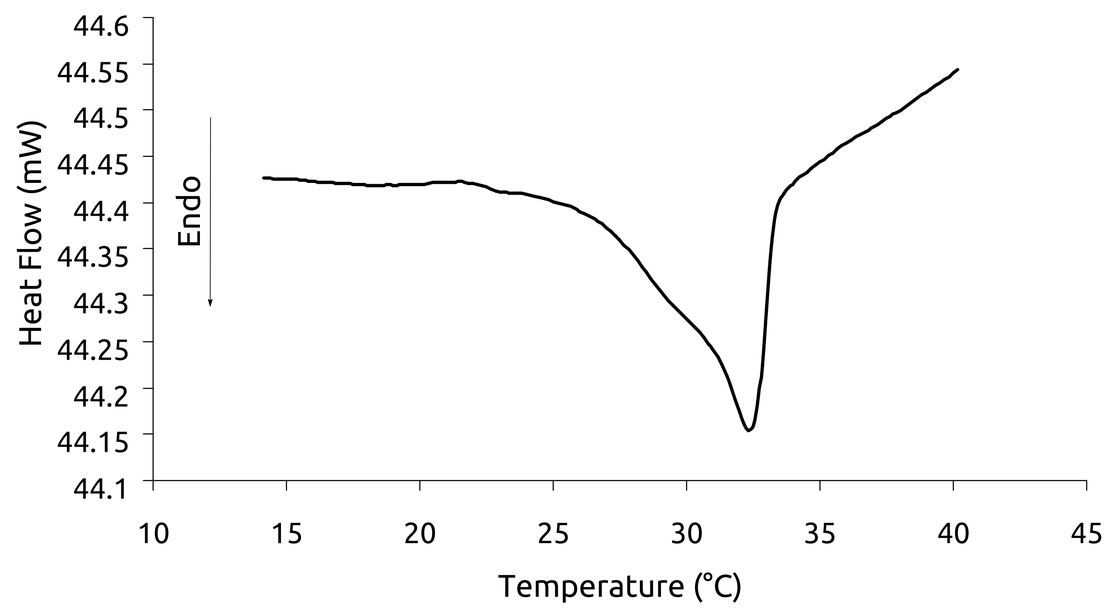


To determine the influence of the temperature on the absorbance of the solutions the temperature was varied between 20 °C and 36 °C, in 2°C/min steps followed by a 5 minute isothermal period, either in the dark or under white light irradiation. When the measurements were taken in the dark, a strong absorbtion peak is observed at 420 nm, corresponding to the protonated merocyanine (MC-H$^+$) form of the SPA. Under white light irradiation, this peak almost completely disappears because the MC-H$^+$ changes its conformation to the closed SPA form. This form is more hydrophobic than the MC-H$^+$ form, thus encouraging the polymer to precipitate.



Turbidity is measured as the increase in absorbance with the increase in temperature, either for a unirradiated solution or for a white light irradiated solution.

DSC Analysis:



The endothermic peak which appears at 32 °C confirms the existence of a LCST temperature. The scanning interval was from 14 °C to 70 °C at a scan rate of 10 °C/minute.

Conclusion

A functional polymer was synthesized by copolymerizing NiPAAm with acrylic acid and SPA. From the UV-Vis measurements taken, it can conclude that the polymer exhibits a color change upon irradiation with white light and also exhibits a lower critical solution temperature around 32 °C. These properties represent a good starting point for the synthesis of temperature and light responsive hydrogels [3].

Acknowledgments

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Reference

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[2.] K. Sumaru, M. Kameda, T. Kanamori, T. Shinbo, *Macromolecules*, **37** (2004) 4949-4955.
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