Smart Photonic Crystals of Stimuli-responsive Microgels

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Abstract

Smart microgels have attracted great attention in soft matter studies for various applications, such as drug delivery vehicles and sensors, owing to their ability to respond to a variety of physical and chemical stimuli, e.g. temperature and pH. Poly (N-isopropylacrylamide) (PNIPAM) with a thermoreversible volume phase transition (VPT) temperature of ~ 32 °C- 34 °C and poly (vinylpyridine) (PVP) with pKa ~ 4 are among the most studied polymers with temperature and pH responsive behavior, respectively. Colloidal crystals of monodisperse microgels made of these polymers can show iridescent colors. The stimuli responsiveness, on top of this, provides them the ability of changing their size and therefore their spacing in colloidal crystals assembly, which results in a color change. Incorporating organic or inorganic dyes in the microgels combine with the structural color further allows one to enhance/tune the color-changing pattern within the system. The objective of this work is to prepare monodisperse pH and temperature-reponsive microgels by means of water-based free radical polymerization methods with modification of previous works [1,2], which can undergo strong change in their size in response to a stimulus. The self-assembly of these microgels into ordered crystalline structures, as well as their ability to either alter their structural order to reversibly move towards a disordered state in response to a stimulus has been investigated (Fig.1 -3).

References

[1]. D. Suzuki, T. Yamagata, K. Horigome, K. Shibata, A. Tsuchida, T. Okubo, *Colloid Polym Sci.* **2012**, 290:107–117

[2]. K. Fan, M. Bradley, B. Vincent, *J. Colloid Interface Sci.* **2010**, 344, 112-116

Figures

Keywords: Stimuli-responsive, Microgels, Color change

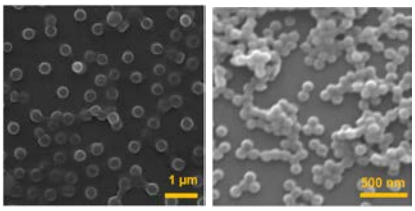


Fig. 1: Microgels morphology- Left: PNIPAM, Right: PVP

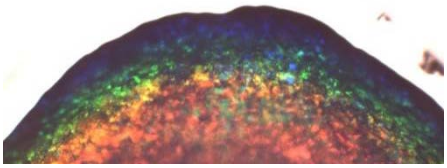
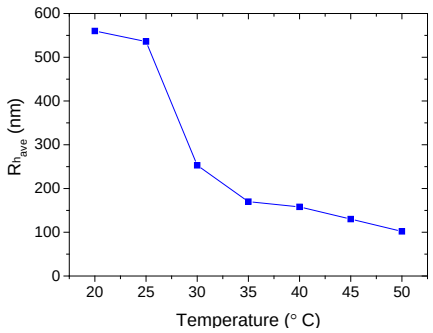


Fig. 3: Drop of liquid PVP microgels on Silicon wafer



pH	Rh $_{ave}$ (nm)
3	198
8	44

Fig. 2: Average hydrodynamic radius change with Left: temperature- PNIPAM, Right: pH- PVP