Real-time measurements of thermo-responsive hydrogel gelation using high-*Q* microbubble resonator sensors

Aiqiang Wang[1], Bing Duan[1], Chuwen Lan[1], Daquan Yang[1,*]

[1]State Key Laboratory of Information Photonics and Optical Communications, and School of information and communication Engineering, Beijing University of Posts and Telecommunications, Beijing 100876, China.
*Corresponding author: ydq@bupt.edu.cn
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Here, real-time and continuous measurements of thermal-responsive hydrogel gelation process are experimentally demonstrated by using high-*Q* whispering-gallery-mode (WGM) microbubble resonator sensors. The wavelength red-shift of 70.99 pm and blue-shift of 69.32 pm are observed during the gel-to-sol transition, respectively.

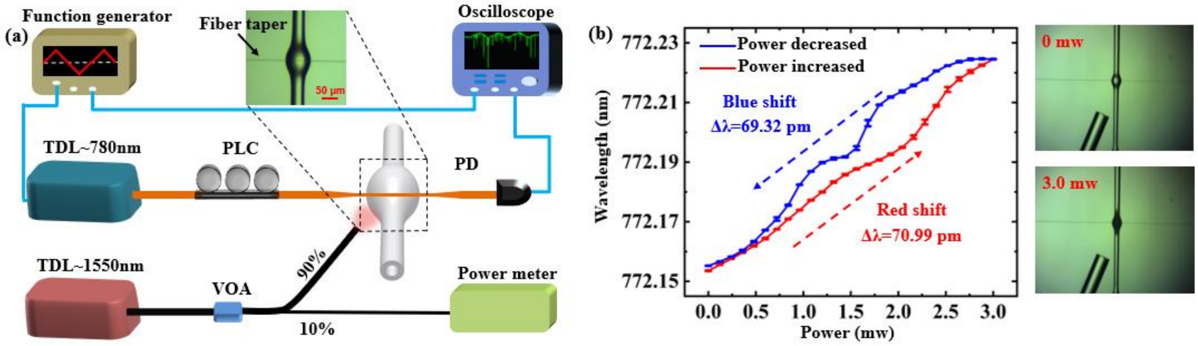

Figure 1. (a) Schematic of experiment setup. TDL, tunable diode laser; PLC, polarization controller; VOA, variable optical attenuator; PD, photodetector. (b) WGM wavelength shifts during the gel-to-sol transition process. Inset: hydrogel state at different heating laser power.

In this work, we monitor the gel-to-sol transition for N-isopropylacrylamide (PNIPA) hydrogel [1]. As shown in Figure 1. (a), The WGMs of microbubble cavity filled up with PNIPA-based hydrogel are excited by a tunable laser at 780 nm, the heating light source is provided by a near-IR laser, operating at 1550 nm. The WGM wavelength shift is linked to refractive index changes during the gel-to-sol process of PNIPA-based hydrogel [2]. When heating the microbubble cavity by increasing the near-IR laser power in the range from 0 mw to 3 mw with a step of 0.12 mw, WGMs wavelength experience a red-shift over time. Considering the inverse solubility of PNIPA, we decreased the heating laser power from 3 mw to 0 mw with the same step. A continuous blue-shift in WMGs wavelength is achieved in PNIPA sols. We tracked a single WGM during the PNIPA gel-to-sol transition, the wavelength red-shift of 70.99 pm is observed in PNIPA gels while wavelength blue-shift of 69.32 pm in PNIPA sols. It is evident that the hydrogel shows gelation behavior as the heating laser power increases, as shown in CCD image. Our sensing method offers a great platform for measuring dynamic biochemical process and may provide more information about gelation kinetics, efficiency and mechanism for hydrogels.

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Reference
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