

Microfluidic production of photo-thermal microheaters using double-emulsion templates

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Gold nanorods have unique optical property of surface plasmon resonance (SPR) depending on their size and aspect ratio. Free electrons on the surface of gold nanorods collectively oscillate by incident light of two distinct energy levels: One for latitudinal mode and the other for longitudinal mode. The longitudinal mode of SPR provide strong light absorption in the near-infrared (NIR) region and conversion into thermal energy; this is called photo-thermal effect. In this study, we encapsulate the gold nanorods with polymeric membrane at high concentration to photo-thermal microheaters. Gold nanorods are synthesized via seed-mediated method and their surface is treated with polyethylene glycol (PEG) to enhance dispersion stability in water. The gold nanorods are encapsulated in the aqueous core of water-in-photocurable oil-in-water double-emulsion drops using a capillary microfluidic device, which are then concentrated by osmosis. The middle oil shell is photo-polymerized by UV exposure. The resultant microcapsules provide photo-thermal microheaters which are injectable and remotely-controllable, thereby potentially providing new opportunity.