

Fabrication of Uniform DNA-Conjugated Hydrogel Microparticles via Replica Molding for Facile Nucleic Acid Hybridization Assays

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We identify and investigate several critical parameters in the fabrication of single-stranded DNA conjugated poly(ethylene glycol) (PEG) microparticles based on replica molding (RM) for highly uniform and robust nucleic acid hybridization assays. The effects of PEG-diacrylate, probe DNA, and photoinitiator concentrations on the overall fluorescence and target DNA penetration depth upon hybridization are examined. Fluorescence and confocal microscopy results illustrate high conjugation capacity of probe and target DNA, femtomole sensitivity, and sequence specificity. Combined these findings demonstrate a significant step toward simple, robust, and scalable procedures to manufacture highly uniform and high capacity hybridization assay particles in a well-controlled manner by exploiting many advantages that the batch processing-based RM technique offers. We envision that the results presented here may be readily applied to rapid and high throughput hybridization assays for a wide variety of applications in bioprocess monitoring, food safety, and biological threat detection.