227d Optimizing Recognition Characteristics of Biomimetic Polymer Gels by Polymerization Reaction Analysis

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This work highlights the rational design of biomimetic recognitive networks via polymerization reaction analysis for application in novel diagnostic or robust point-of-care devices. Non-covalent complexation interactions between template or ‘guest' biomolecules and functional monomers during polymerization can create networks with selective binding sites for biomolecules within polymeric films. The concept of macromolecular recognition manifests itself from two major synergistic effects, (i) shape specific molecular cavities that match the template biomolecule and (ii) structured chemical groups oriented to form multiple complexation points with the template molecule. The resulting polymer networks are selective due to the particular chemistry of the binding site, the orientation and stabilization of the chemistry in a crosslinked matrix, as well as by the size and shape of the site for the template biomolecule. Polymerization reactions of biomimetic acrylate and methacrylate based templated systems were analyzed (chain propagation, termination kinetics, final double bond conversion, etc.) to tailor the functional design of networks with optimized template affinity, selectivity, loading, and diffusional properties. To study rational design, compositional parameters such as the amount of crosslinking monomer in the feed, size of crosslinking monomer, monomer/template ratio, temperature of reaction, weight percent and type of initiator, etc., were varied. Results demonstrate that a decrease in the total number of double bonds reacted as well as an increase in the linear size of the crosslinking monomer leads to a significant decrease in template equilibrium association constants. It also highlights that the final polymer composition does not represent feed compositions when using significant amounts of short bifunctional crosslinking monomer (i.e., intra-molecular distances between crosslinking monomer double bonds are short). Overall, an increase in double bond conversion by optimizing the polymerization reaction is shown to dramatically improve binding parameters, and the use of controlled living polymerization techniques demonstrate the potential for greater control over recognition properties.