Binding Studies on Molecularly Imprinted Polymers

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Abstract

Molecular imprinting is a rapidly developing technique for preparation of polymeric materials that are capable of molecular recognition for selective separation and chemical identification. To prepare molecularly imprinted polymers (MIPs), a functional monomer and a crosslinker are polymerized in the presence of a template molecule. Then the template is extracted leaving sites which are complementary in both shape and chemical functionality to those of the template. This resin then becomes capable of selectively absorbing the template species. Because of MIPs' stability, predesigned selectivity, and easy preparation, they have been used for separation, sensor, drug development and directed synthesis.

In this study, we focused on characterizing and understanding the mechanism underlying formation and recognition of MIPs. Three resins imprinted with 4-hydroxybenzoic acid, 3-hydroxybenzoic acid and 6-methoxy-α-methyl-2-napthaleneacetic acid ((*S*)-naproxen) were prepared in a free radical polymerization. Hydrogen bonding between the template and functional monomer is the main interaction: it not only controls the template molecules in and out of the binding sites, but also contributes a high concentration of specific binding sites in the resulting polymer resin. After polymerization, the amount of template that can be effectively removed during each extraction was quantified in the naproxen imprinted system. For comparison, another resin was prepared under the same condition without the presence of the template, which was designated as NIP.

The binding experiments were performed for the affinity and selectivity tests. The MIP showed a special affinity for the template, but not for other analytes, which is consistent with the principle that an imprinted resin's recognition ability is dependent on the analyte's size, shape, and functionality. The NIP had similar affinities for the analytes and thus it could not differentiate among them. The binding behavior of the MIP is characterized by an association constant and the density of each kind of site using a simple two-binding-site model with one kind of sites special for the template and the others being more general with similar affinities as the NIP. The binding sites common to both the imprinted resin and the non-imprinted resin were found to have higher affinity but are less numerous than the sites unique to the imprinted resin.