Seminar

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Functionalized Cucurbiturils and Their Applications

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Cucurbit[*n*]uril (CB[*n*], *n* = 5 – 10),[1] a new family of host molecules comprising *n* glycoluril units, have a hydrophobic cavity and two identical carbonyl-laced portals, which allow them to form stable inclusion complexes with a wide variety of guest molecules. For example, CB[7] forms very stable host-guest complexes with ferrocenemethyl-ammonium (FA) ions in water with a binding constant up to 10^{15} M^{-1}.[2] It is one of the highest binding affinity ever observed in synthetic receptors and quite close to that of the biotin-avidin pair (10^{13} – 10^{15}). Our recent discovery of a direct functionalization method of CB[*n*] allowed us to synthesis a wide variety of tailor-made CB[*n*] derivatives and explore new applications of the host family.[3] For example, lipophilic alkylated CB[*n*] (*n* = 5, 6) behaves as an ion channel when embedded in a lipid bilayer. Amphiphilic CB[6] derivatives form vesicles whose surface can be easily modified by host-guest interactions, which may be useful in targeted drug delivery. We recently synthesized polymer nanocapsules via polymerization of allyloxyCB[6] which has a rigid core and multiple polymerizable allyl groups at the periphery.[4] Without needs for any pre-organized structures or templates, and core-removal the reaction directly produces polymer nanocapsules with a stable structure and narrow size distribution. The polymer shell made of host molecules allows tailoring of the surface properties by host-guest interactions. The easy synthesis and unique ability to tailor surface properties in a noncovalent manner make the polymer capsules and vesicles potentially useful in many applications including targeted drug delivery. We also reported a novel noncovalent method to immobilize a protein on a solid surface using the CB[7]–FA pair, which may serve as a replacement of the avidin-biotin system for this and other applications.[5] Some of our recent work will be presented.

References

1. Reviews: (a) J. W. Lee et al. *Acc. Chem. Res*. **2003**, *36*, 621, (b) K. Kim, *Chem. Soc. Rev*. **2002**, *31*, 96, (c) L. Isaacs et al, *Angew. Chem. Int. Ed*. **2005**, *44*, 4844.
2. (a) W. S. Jeon et al. *J. Am. Chem. Soc.* **2005**, *127*, 12984, (b) M. V. Rekarsky et al. *PNAS*, **2007**, *104*, 20737.
3. K. Kim et al. *Chem. Soc. Rev*. **2007**, *36*, 267.
4. D. Kim et al. *Angew. Chem. Int. Ed.* **2007**, *46*, 3471.
5. I. Hwang et al. *J. Am. Chem. Soc.* **2007**, *129*, 4170.

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