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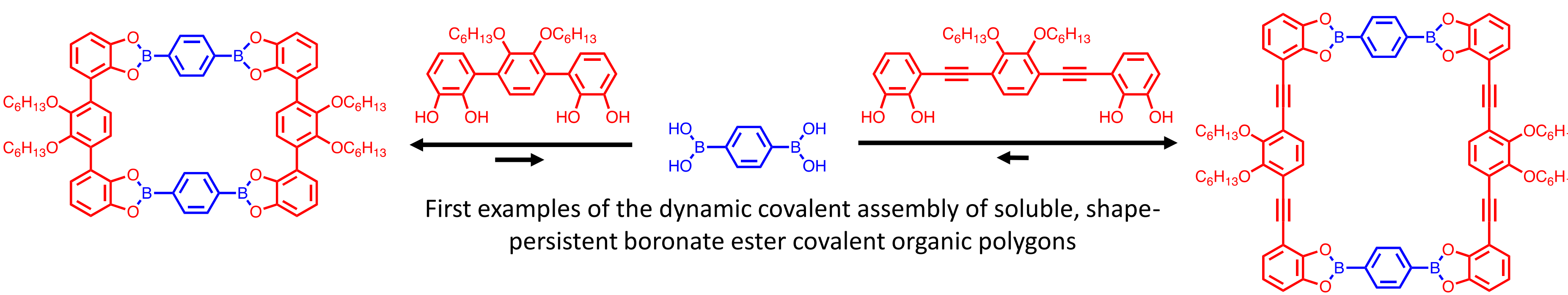
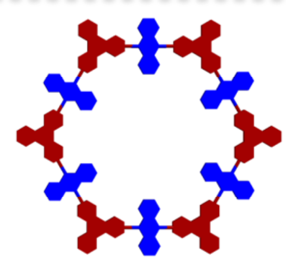
Dynamic Assembly of Porous Boronate Ester Macromolecules

The design and synthesis of shape-persistent macrocycles containing well-defined nanoscale cavities is of great interest given the multiple applications of nanoporous materials in chemical sensing, separations, storage, and catalysis. While several examples of shape-persistent macrocycles have been reported, most rely on tedious, inefficient, and low yielding stepwise procedures that are impractical to implement on larger scales. An alternative means of preparing complex materials is through self-assembly of specially designed molecular precursors. We have developed the use of dynamic covalent self-assembly of catechol derivatives with aryl boronic acids to give shape-persistent boronate ester macrocycles with well-defined nanoscale pores. These discrete polygons are two dimensional analogues of related covalent organic framework structures that have numerous applications ranging from gas uptake and storage to organic photovoltaics. Infinite frameworks, however, are insoluble materials that are largely unable to be modified once prepared. The discrete, soluble covalent organic polygons we have successfully prepared allow for greater control over their higher-order assembly, e.g. on surfaces, in solution, as liquid crystalline materials, and in the solid state through crystal engineering.



First examples of the dynamic covalent assembly of soluble, shape-persistent boronate ester covalent organic polygons

We have recently prepared the first examples of rectangular boronate ester macrocycles. We are currently adapting our successful synthetic techniques to the dynamic self-assembly of more complex macrocycles with larger nanoscale pores.



– Porous solids –

– Boronate ester mesogens –

– Chemical sensing –

– Non-linear optical materials –