

Towards the Rational Design of 3D Molecular Architectures via Dynamic Covalent Chemistry

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Dynamic covalent chemistry (DCC) has recently proven to be a powerful tool to construct shape-persistent molecular architectures including macrocycles, cages, and covalent organic frameworks from multitopic constituents. The ability of these reactions to proceed via thermodynamic control – ultimately allowing for error-correction and the formation of thermodynamically stable products – provides an avenue towards synthesizing complex molecules in one-pot methodologies with high yields. Yet, because DCC reactions often encounter significant kinetic barriers which challenge the approach toward equilibrium, it remains difficult to direct DCC along kinetically viable pathways and predict the structural outcome of a multitopic precursor subjected to DCC. Herein, we address this problem by testing the hypothesis that precursor bite angle governs the product distribution of dynamic alkyne metathesis (AM). A series of tritopic precursors were rationally designed to have different bite angles but analogous molecular geometries. Upon subjecting each precursor to AM, we observed distinct differences in the resulting product distributions. The example reported here illustrates how slight adjustments in precursor design greatly affect the outcome of DCC reactions. We anticipate our findings to contribute towards rational design principles that outline strategies to overcome DCC's kinetic challenges and allow the design of complex covalent molecular architectures a priori.

