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Bottom-up fabrication of functional systems possessing high level complexity and order comparable to that of living organisms is the ultimate goal of molecular nanotechnology. Thanks to the rapid progress of DNA nanotechnology, especially DNA Origami technique, we are now able to make nanoscale objects with fairly complicated geometry. It is still difficult, however, to build structures in larger scale not just a periodic or a random assembly of motifs. In order to realize complex and well-organized structures in large scale, a completely new approach must be introduced. We think our method to control the number of unit in a homogeneous assembly gives the basis of it. Let us explain our concept toward this future.

In this BIOMOD project, we have developed an origami monomer that assembles into a strut with desired length. Now we need a junction to combine the struts, ideally, a junction which can change the number of struts joined at the junction (Fig.1). Various combinations of multimers, junctions and existing DNA motifs enables us to make a variety of basic components with different configurations. Moreover, these components can be built into a further complicated system in a programmable way utilizing the principle of DNA computing. Because the stacking number in the strut and the number of struts gathering at the junction can be controlled by small amount of interfering DNA strands and the DNA logic gate can provide such a signal molecule in response to various environmental conditions. Using these “intelligent” components, we anticipate to construct diverse molecular systems with high level complexity and order (Fig. 2).