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In nature, various biological functions are realized by multimeric proteins. In most cases, these proteins have intrinsic curvature and the number of monomers are determined by their circular assembly. However, in linear assembly, it is difficult to control the number of proteins without additional capping mechanisms. Here, we propose a novel mechanism to control the linear assembly by using a kind of vernier mechanism.

We designed a DNA origami monomer with the vernier mechanism. It consists of a cylinder and a twisted shaft, where the shaft can rotate inside the cylinder. Since the shaft is slightly twisted, there is a phase shift between stacking angles on its ends. As the monomers stack, the phase shift accumulates on the shaft. When the accumulated twist reaches the limit defined on the cylinder, the stacking procedure is inhibited.

Our design enables us to make size-controllable DNA origami complexes, which provide a novel possibility for structural nanotechnology.