ABSTRACT

The unique structural motifs and self-recognition properties of DNA can be exploited to generate self-assembling DNA nanostructures of specific shapes using a ‘bottom-up’ approach[1](https://www.nature.com/articles/nature07971#ref-CR1). Several assembly strategies have been developed for building complex three-dimensional (3D) DNA nanostructures[2](https://www.nature.com/articles/nature07971#ref-CR2),[3](https://www.nature.com/articles/nature07971#ref-CR3),[4](https://www.nature.com/articles/nature07971#ref-CR4),[5](https://www.nature.com/articles/nature07971#ref-CR5),[6](https://www.nature.com/articles/nature07971#ref-CR6),[7](https://www.nature.com/articles/nature07971#ref-CR7),[8](https://www.nature.com/articles/nature07971#ref-CR8). Recently, the DNA ‘origami’ method was used to build two-dimensional addressable DNA structures of arbitrary shape[9](https://www.nature.com/articles/nature07971#ref-CR9) that can be used as platforms to arrange nanomaterials with high precision and specificity[9](https://www.nature.com/articles/nature07971#ref-CR9),[10](https://www.nature.com/articles/nature07971#ref-CR10),[11](https://www.nature.com/articles/nature07971#ref-CR11),[12](https://www.nature.com/articles/nature07971#ref-CR12),[13](https://www.nature.com/articles/nature07971#ref-CR13). A long-term goal of this field has been to construct fully addressable 3D DNA nanostructures[14](https://www.nature.com/articles/nature07971#ref-CR14),[15](https://www.nature.com/articles/nature07971#ref-CR15). Here we extend the DNA origami method into three dimensions by creating an addressable DNA box 42 × 36 × 36 nm3 in size that can be opened in the presence of externally supplied DNA ‘keys’. We thoroughly characterize the structure of this DNA box using cryogenic transmission electron microscopy, small-angle X-ray scattering and atomic force microscopy, and use fluorescence resonance energy transfer to optically monitor the opening of the lid. Controlled access to the interior compartment of this DNA nanocontainer could yield several interesting applications, for example as a logic sensor for multiple-sequence signals or for the controlled release of nanocargos.