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An origami logic gate for detection of lung cancer

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In this study, we designed and synthesized a self-assembled DNA complex that sense six lung cancer microRNA markers and produce a fluorescent output corresponding to the operation of an AND gate. Logic gates are devices that perform logical operations by transforming a set of inputs into a predictable single detectable output. To perform the logic gate, we have placed two fluorophores at the DNA origami with an optimum inter-distance of ~2 nm. We used FRET method to demonstrate the activity of our constructed DNA origami, where a high FRET efficiency at the initial state of the origami demonstrated the origami being in closed state. Addition of the microRNA mimics (DNA strands with identical genetic information of the lung cancer microRNAs), leads to strand displacement of the DNA locks. As a result, DNA origami conformation switches to open state and thus the examined FRET efficiency change drastically. An example of experimental results of FRET experiments is shown below. Integrating logic gates with DNA origami systems opens a vast avenue to many applications in the fields of nano-medicine, bio-computing and bioelectronics.

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