Controlling photoacoustics enhancement with DNA nanostructures

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Molecular processes that occur on the nanometer scale can be studied using fluorescence molecular rulers based on the Förster resonance energy transfer (FRET) mechanism.[1] One important limitation of these fluorescent pairs is that their use in biological samples is limited to shallow imaging depths due to the light scattering.[2] The use of photoacoustic tomography (PAT)- a recently emerged high resolution modality for in vivo imaging that that combines optical excitation with ultrasound detection- represents an interesting approach to study such processes at centimeter depths.[3] However the capability to produce controlled distance dependent PA signal has not yet been proved.

In order to investigate this, we have exploited the capabilities provided by DNA nanotechnology to fabricate several DNA helices containing fluorophore-quencher pairs located over a range of different controlled distances. We have shown that PAT of the DNA helices showed distance-dependent PA signal generation (see figure 1) and experimentally demonstrated the potential use of PAT to reveal deep FRET processes within tissue mimicking phantoms.[4]

We have also demonstrated that DNA nanostructures are unique nanomaterials to augment the intrinsic PA signal of small molecule fluorescent Near Infrared (NIR) dyes.[4] This property together with their biocompatibility make them very promising contrast agent nanocarriers for cancer biomaging using PAT.

References

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Figure

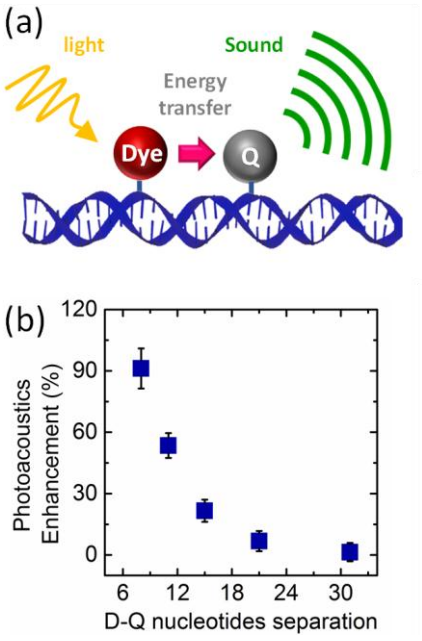

Figure 1: (a) Scheme and (b) graph showing the enhancement of PA signal as the distance between a dye and a quencher attached to a DNA helix platform is reduced.