A 2D DNA Lattice as an Ultra-Sensitive Detector for Beta Radiations

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Supporting Figures and Tables:

Figure S1. A schematic diagram of the double-crossover (DX) [DX = (DX-1) + (DX-2)] tiles. Each tile consisted of four strands: DX1-1, DX1-2, DX1-3, and DX1-4 for the (DX-1) tile, and DX2-1, DX2-2, DX2-3, and DX2-4 for the (DX-2). The complementary sticky end pairs are shown as Sn and Sn' in the sequence drawings (blue).
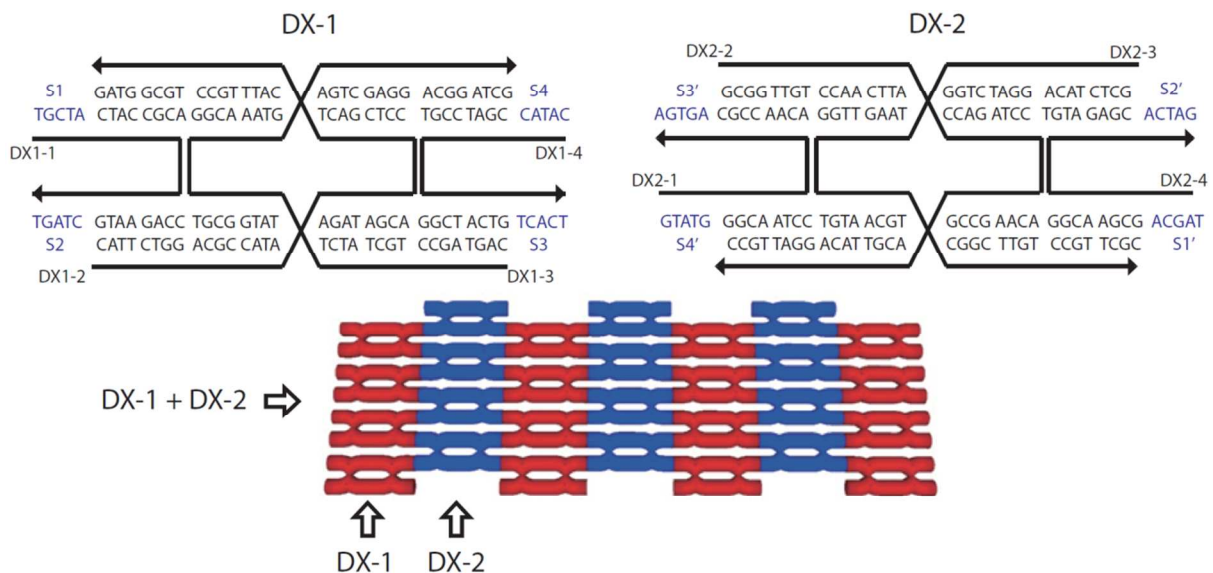
Table S1. Sequence pool for the double-crossover (DX) tiles.

| Strand name	Total # of NTs	Base Sequences (5' to 3')
DX1-1	26	TGCTA CTACCGCA CCAGAATG CTAGT
DX1-2	48	CATTCTGG ACGCCATA AGATAGCA CCTCGACT CATTTGCC TGCGGTAG
DX1-3	48	CAGTAGCC TGCTATCT TATGGCGT GGCAAATG AGTCGAGG ACGGATCG
DX1-4	26	CATAC CGATCCGT GGCTACTG TCACT
DX2-1	26	GTATG GGCAATCC ACAACCGC AGTGA
DX2-2	48	GCGGTTGT CCAACTTA CCAGATCC ACAAGCCG ACGTTACA GGATTGCC
DX2-3	48	GCTCTACA GGATCTGG TAAGTTGG TGTAACGT CGGCTTGT CCGTTCGC
DX2-4	26	TAGCA GCGAACGG TGTAGAGC ACTAG

Table S2. Sticky-ends for the double-crossover (DX) tiles shown in **Figure S1.**

	5' to 3'	3' to 5'	
S1	TGCTA	ACGAT	S1'
S2	CTAGT	GATCA	S2'
S3	TCACT	AGTGA	S3'
S4	CATAC	GTATG	S4'

Figure S2. AFM images of plotting the deformation area curves in **Figure 2(f, g).**
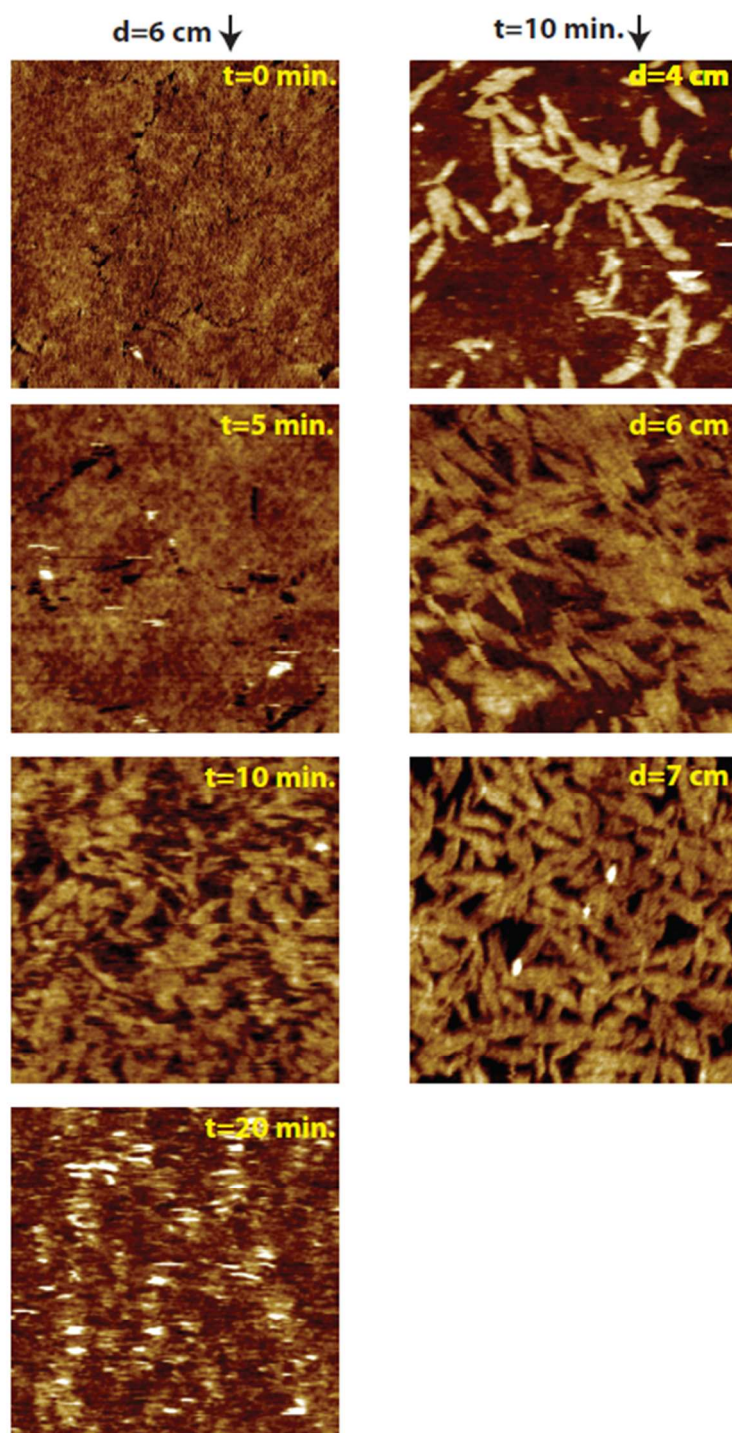
Figure S3. The reflectance intensities of DI water, $1\times$TAE/Mg^{2+} buffer, and DNA lattices on glass without radiation exposure.
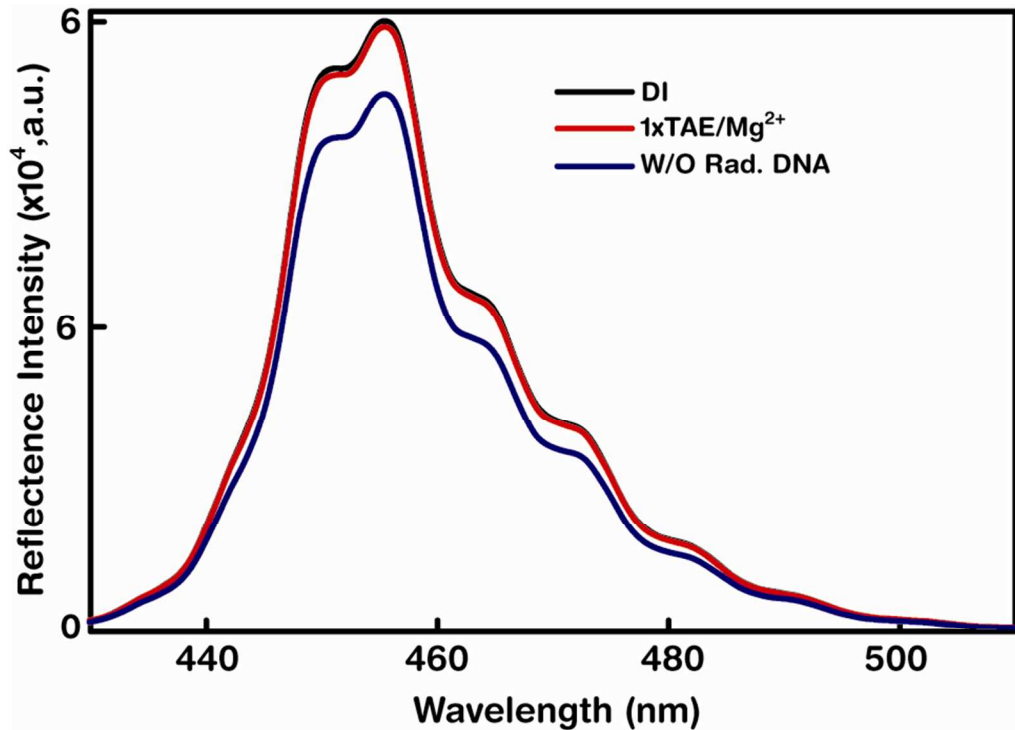
Quantitative description of a DXL (Double-Crossover Lattice)
M1. Definition

- DXL structure consists of two repeating tiles, DX-1 and DX-2.
- Each DX-1 and DX-2 tile is made up of four DNA strands.
- A pair of DX-1 and DX-2 tiles is referred to as single DXL unit.

M2. Total number of DXL units on the surface

- The size of the substrate is 5 mm × 5 mm.
- The total DNA polycrystalline lattice area = 25 mm^2 = A$_{tot}$
- The occupied size of single DX tile is 5 nm × 12 nm.
- Total number of tiles on the surface is $\frac{5 \text{ mm} \times 5 \text{ mm}}{5 \text{ nm} \times 12 \text{ nm}} = 42 \times 10^{10}$ tiles.
- Total number of DXL units on the surface is 21×10^{10} units.

M3.DNA base pair concentration on given substrate.

- 1 mole = 6.022×10^{23} units.
- 1 unit = $(1/(6.022 \times 10^{23}))$ mol = 1.661×10^{-24} mol
- Total DXL concentration = $(21 \times 10^{10}$ DXL units$) \times (1.661 \times 10^{-24}$ mol/DXL unit$)$ = 3.488×10^{-13} mol
- 1 unit has 69 base pairs of AT and 79 base pairs of CG.
- The total AT & CG concentration on glass is,
- AT : (69 bp/unit) × (3.488×10^{-13} mol) = 24.07×10^{-12} mol

- CG : (79 bp/unit) × (3.488 × 10^{-13} mol) = 27.56 × 10^{-12} mol

	Adenine	Thymine	Guanine	Cytosine
M.W of Nucleotide (g)	331.22	322.21	347.22	307.20
M.W of Base Pair (g)	653.43		654.42	

M4. DNA molecules' weight on glass
- AT: (653.43 g/mol) × (24.07 × 10^{-12} mol) = 15.72 ng
- CG: (654.42 g/mol) × (27.56 × 10^{-12} mol) = 18.03 ng
- Total DNA weight: 33.75 ng

M5. Hydrogen bond energy of AT and CG
- AT = 21 kJ/mol or 3.4 ×10^{-20} J/AT
- CG = 29 kJ/mol or 4.8 ×10^{-20} J/CG

M6. Hydrogen bond energy per unit DXL
- (3.4 × 10^{-20} J × 69) + (4.8 × 10^{-20} J × 79) = 6.13 × 10^{-18} J