SCHOOL OF BIOLOGICAL AND CHEMICAL SCIENCES
QUEEN MARY UNIVERSITY OF LONDON

# CONTROLLED ORGANIZATION OF DNA ORIGAMI ON NANO-PATTERNED SURFACES

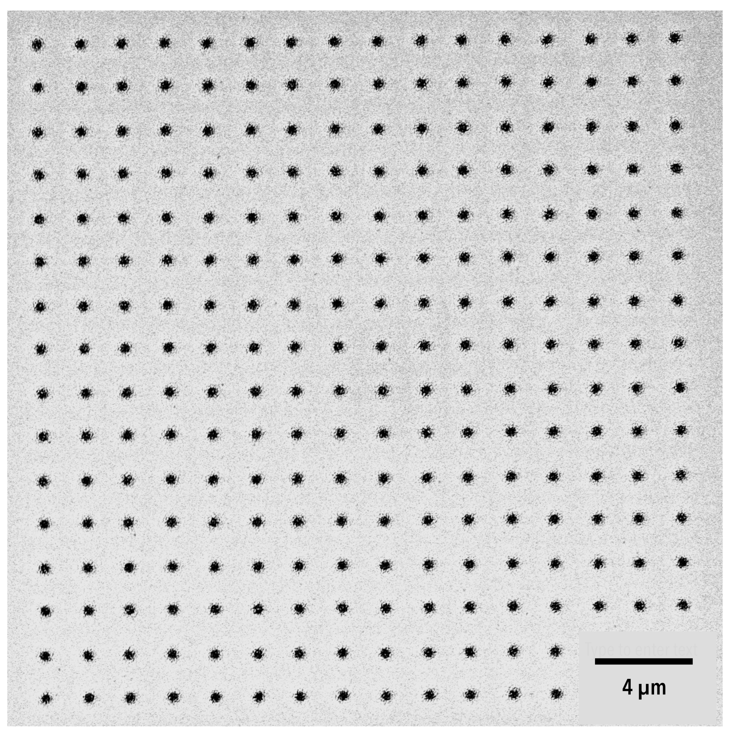
DA HUANG, MARK FREELEY, MATTEO PALMA*

d.huang@qmul.ac.uk

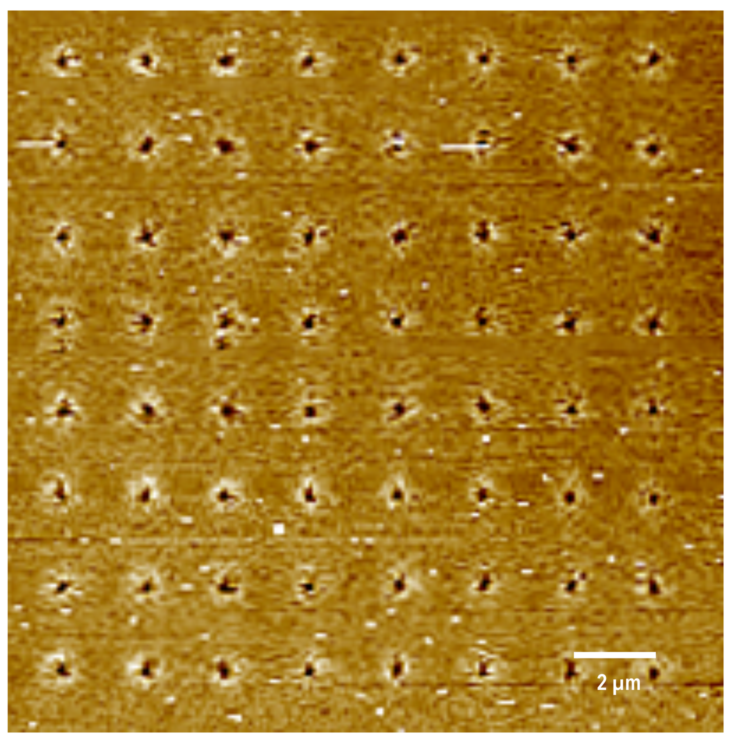
## INTRODUCTION

- DNA origami[1] can be employed as scaffolds to pattern bioactive structures and nanostructures at the scale of individual molecules.
- We present novel strategies to organize DNA nanostructures on nano-patterned surfaces with nanoscale resolution using Focused Ion Beam (FIB).
- Investigations were carried out via scanning electron microscopy (SEM) and atomic force microscopy (AFM) approaches.
- With modern analysis methodologies, this can be used to pattern bioactive structures precisely at the scale of individual molecules for biological investigation.

## RESULTS

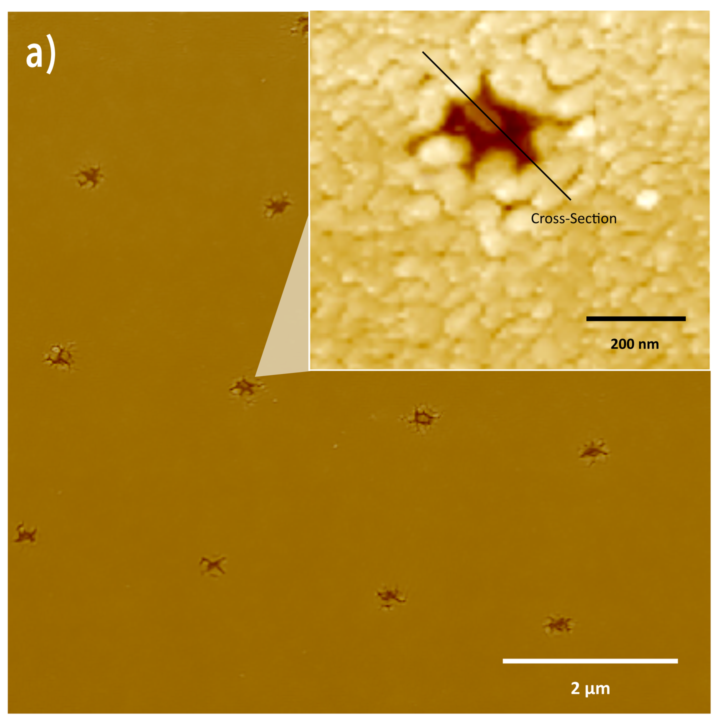



- SEM image of patterned nano-arrays with a spacing of ≈2 μm (~150nm aperture).

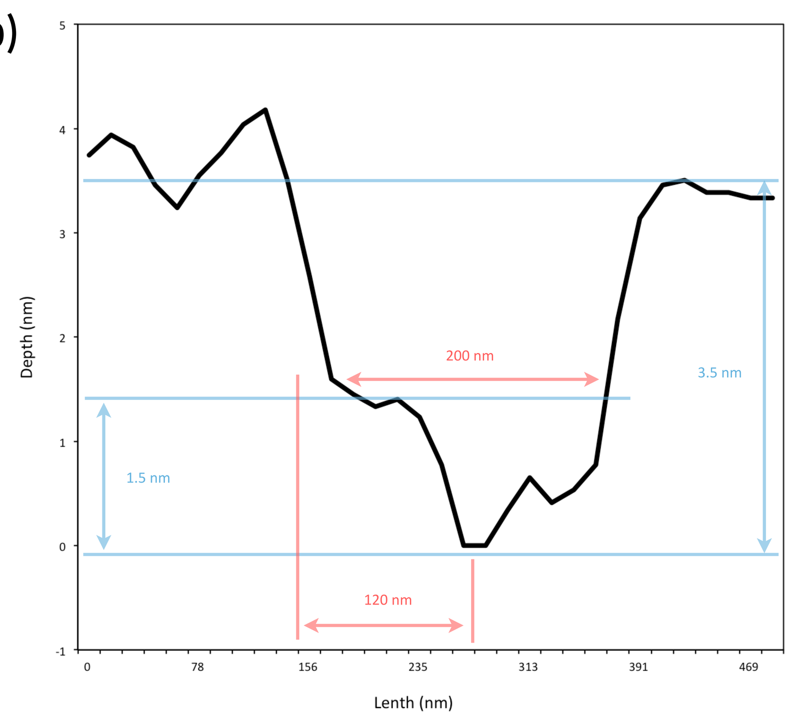



- AFM image of patterned nano-arrays. Depth scale: 3 nm.

a)




b)

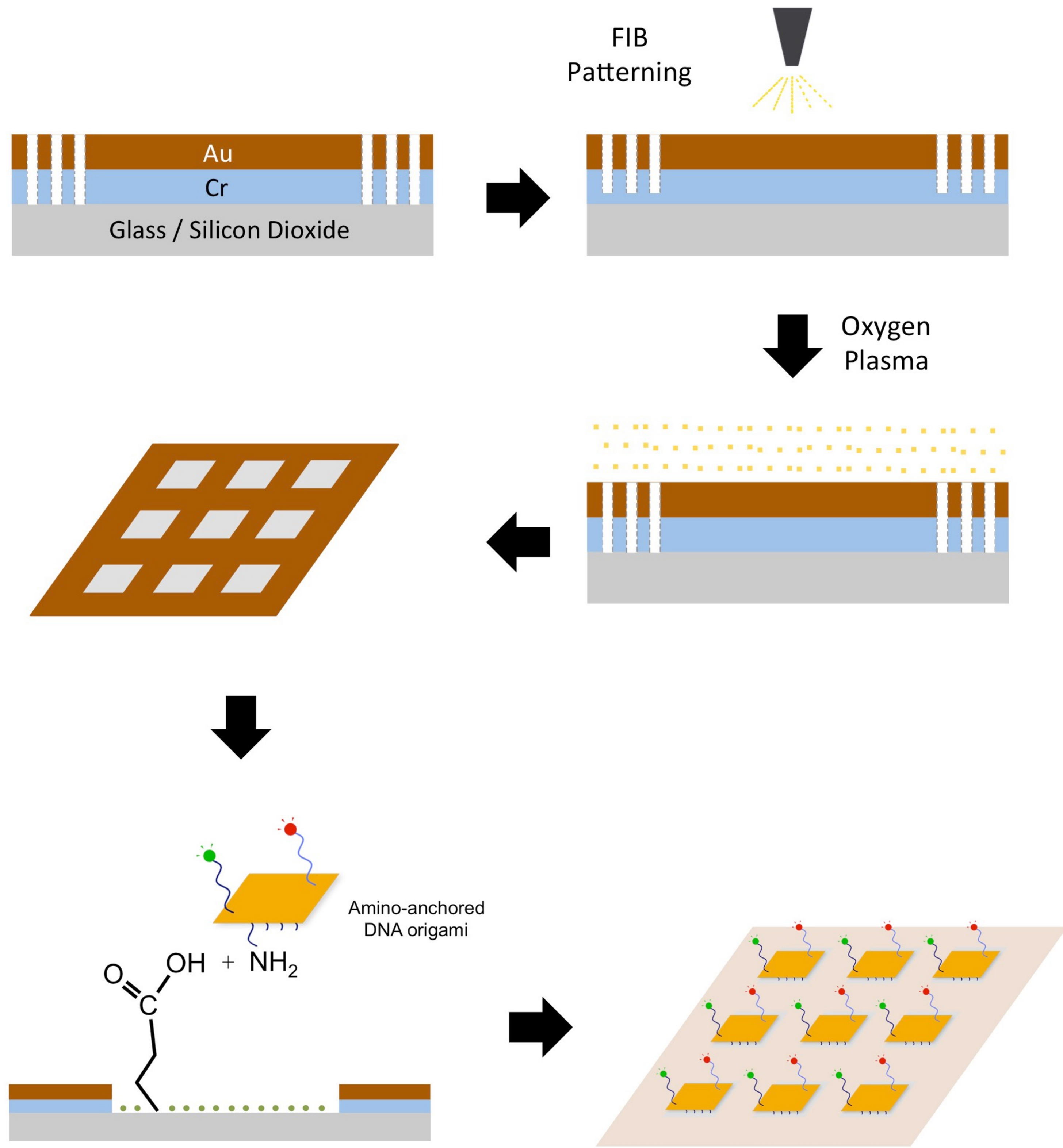



- AFM image for checking the DNA origami immobilisation.

a) High yield of DNA origami immobilisation on the nano-apertures (yield=96%). The inset shows a single aperture with an individual DNA origami in it. .

b) AFM topographical cross-section of a single DNA origami in a nano-patterned aperture: the right size and depth of the DNA origami is confirmed.

## METHODS




- Nano-patterning on glass/silicon dioxide surfaces.

  Schematic illustration of the nano-fabrication strategy via FIB patterning. Glass or silicon dioxide substrates with chromium layer (~1 nm) and gold layer (~2 nm) on top are exposed to the FIB and a nano-array with ~150 nm square apertures is fabricated. The exposed areas are then cleaned with oxygen plasma. A carboxylic terminating SAM is formed via silanization of the exposed $SiO_2$ in the nano-apertures. Finally DNA origami are covalently immobilized[2,3] on the nano-patterned areas.

## CONCLUSIONS

- This new nanofabrication technique using FIB combined with site-specific surface amine covalent bonding immobilisation enables the controlled organization of DNA origami on surfaces over a large area. This approach is of general applicability for the controlled organization of nanostructures on surfaces.
- We can expect this strategy combined with other lithography approaches to control a variety of different modified DNA origami on the same substrate surface. This can be further applied to the fabrication of biochips.

## REFERENCES

(1) Rothemund, P. W. K. Folding DNA to create nanoscale shapes and patterns. Nature 2006, 440, 297–302.

(2) Gopinath, A. & Rothemund, P. W. K. Optimized Assembly and Covalent Coupling of Single-Molecule DNA Origami Nanoarrays. ACS Nano 2014, 8, 12030– 12040.

(3) Gerdon, A. E. et al. Controlled delivery of DNA origami on patterned surfaces. Small 2009, 5, 1942–1946.