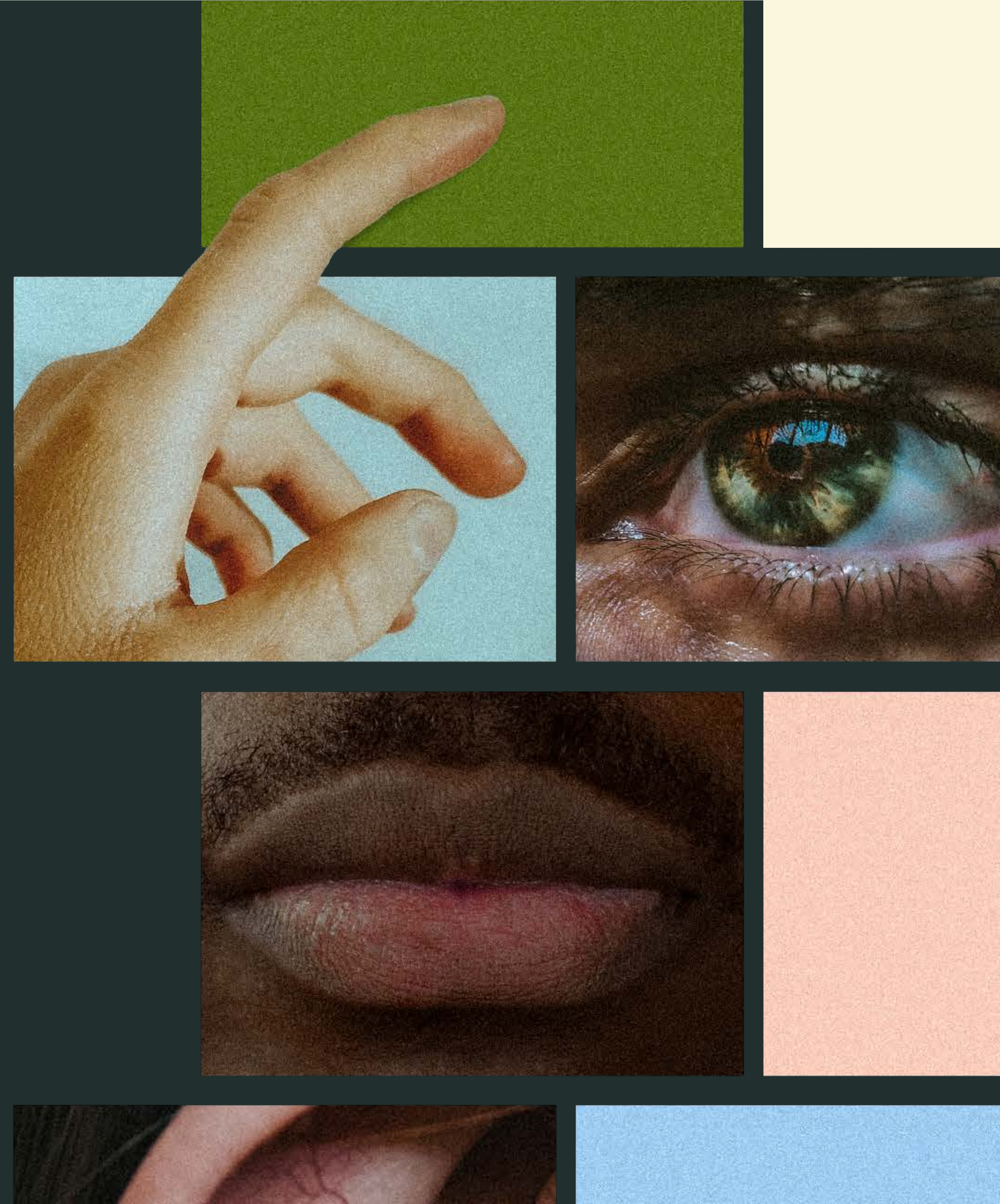




DNA Automation with Nano-Structured Ceramics

Mario Blanco, PhD
Nanopec CEO

October 20, 2022

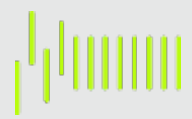




This webinar is hosted by:



The Nanotechnology Application and Career Knowledge (NACK) Resource Center is a National Science Foundation (NSF) Advanced Technology Education (ATE) Regional Center for Nanofabrication Manufacturing Education. NACK is a subsidiary of the Center for Nanotechnology Education and Utilization (CNEU) in the Penn State College of Engineering's department of Engineering Science and Mechanics.



Host



Zac Gray
Managing Director
NACK Center / CNEU

Co-host



Vishal Saravade
Assistant Teaching
Professor
CNEU

Presenter



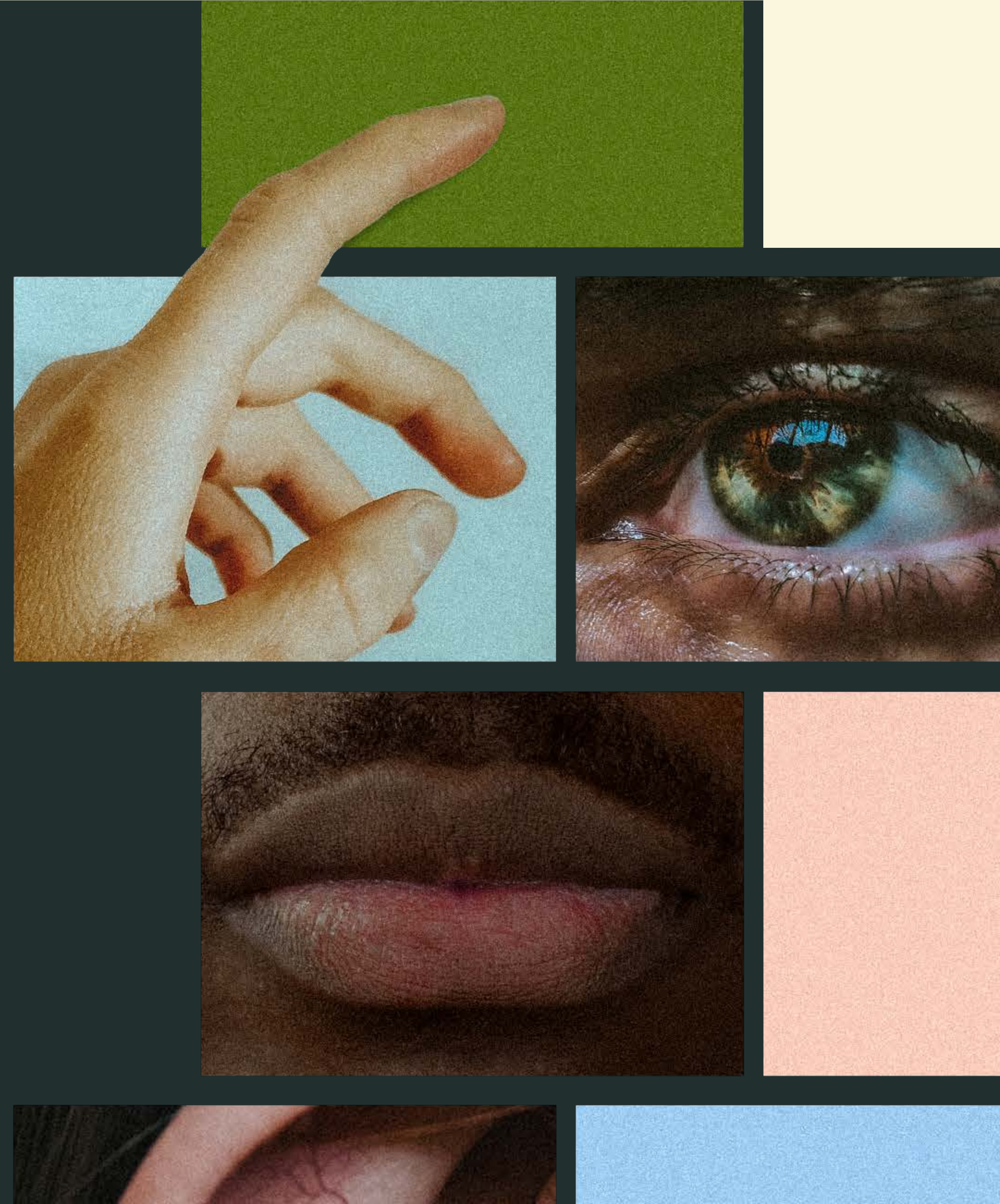
Mario Blanco
President & CEO
Nanopec



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DNA Synthesis Automation Goals

Realize the full potential of
Synthetic Biology
to protect
to heal
to improve
the quality of our lives

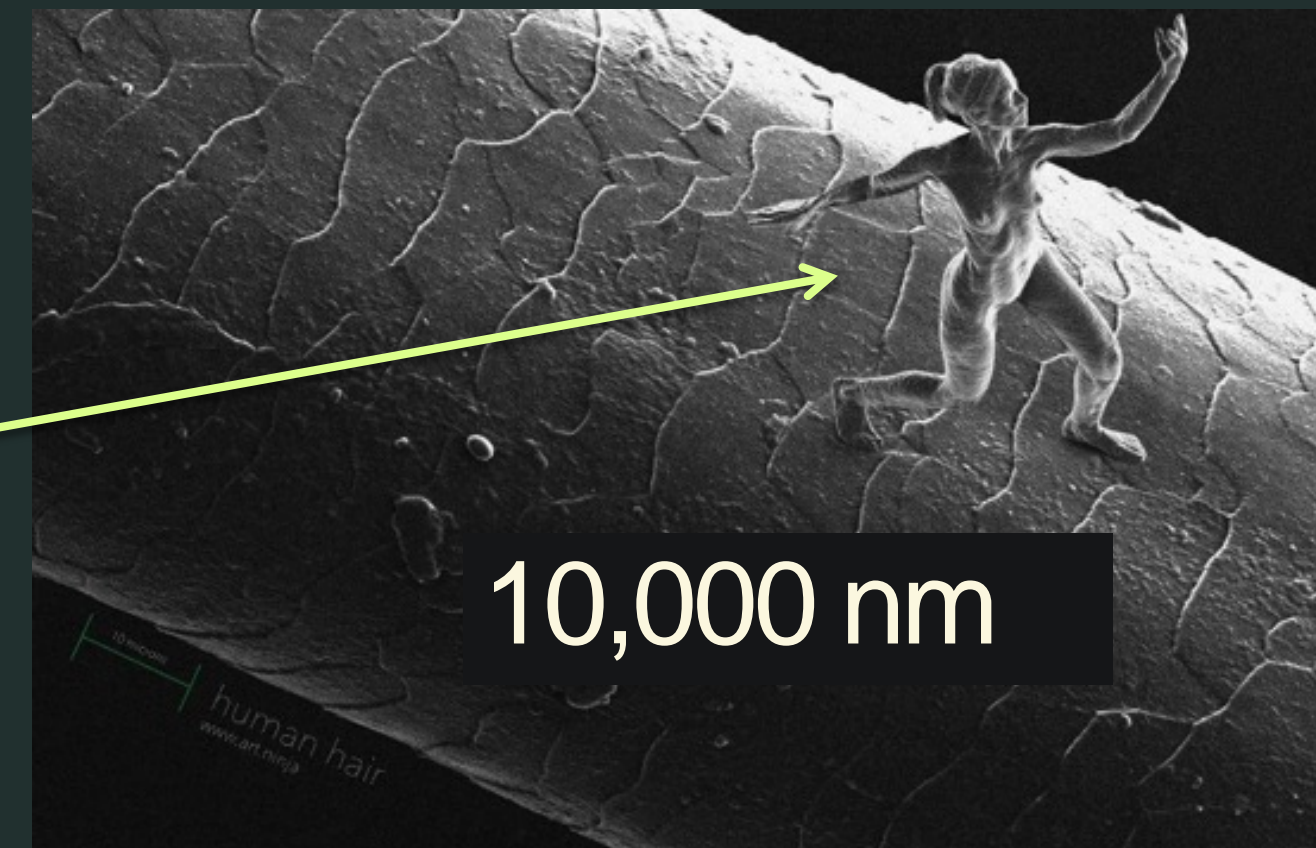
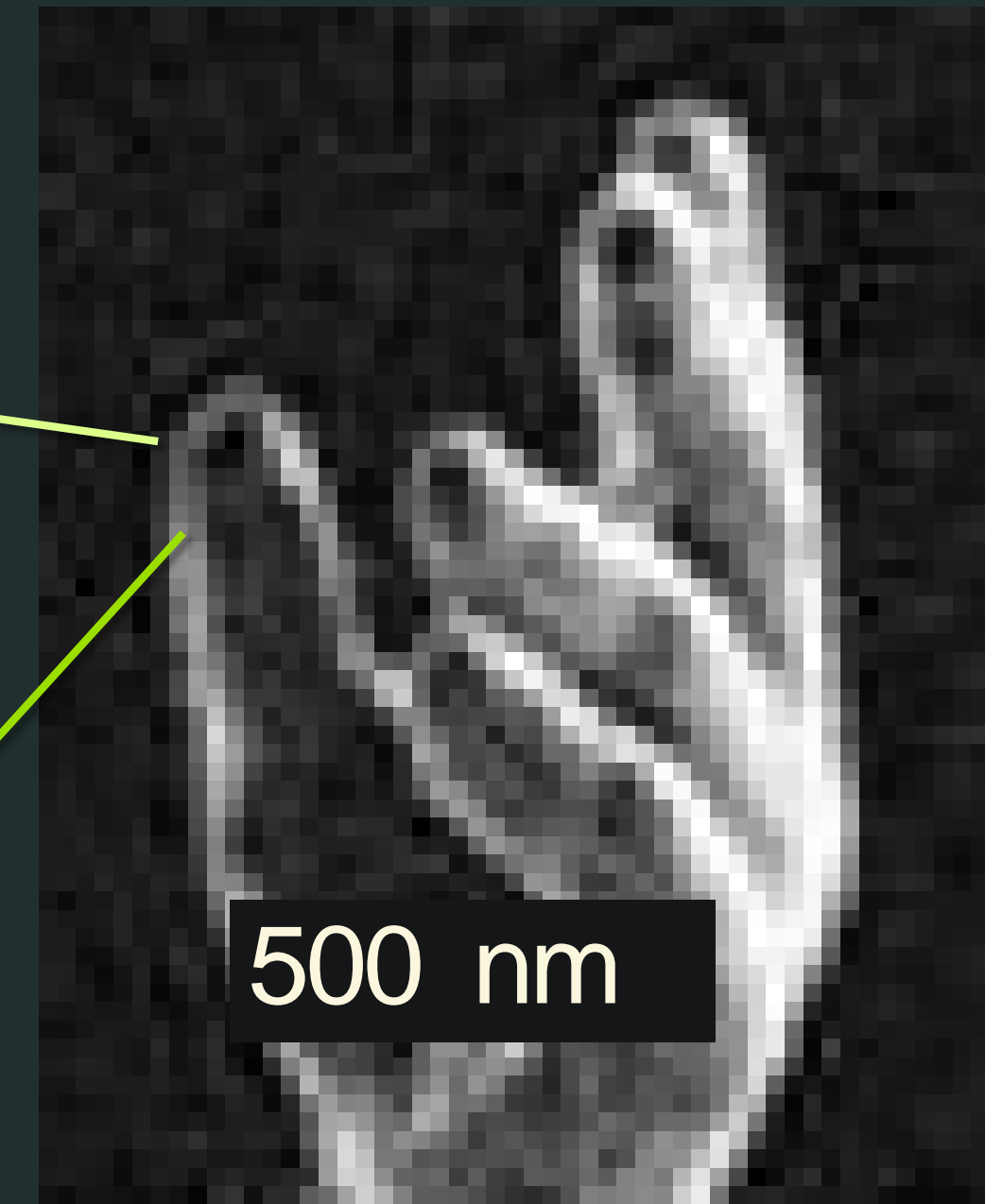
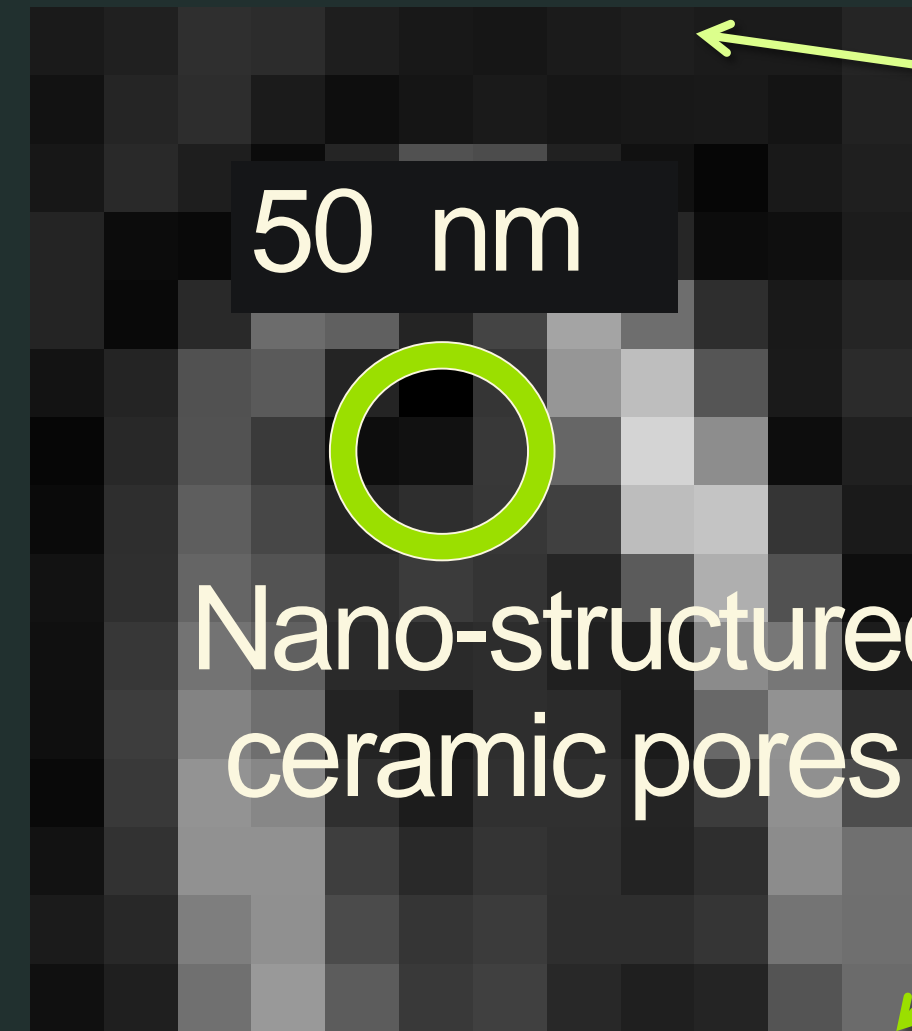
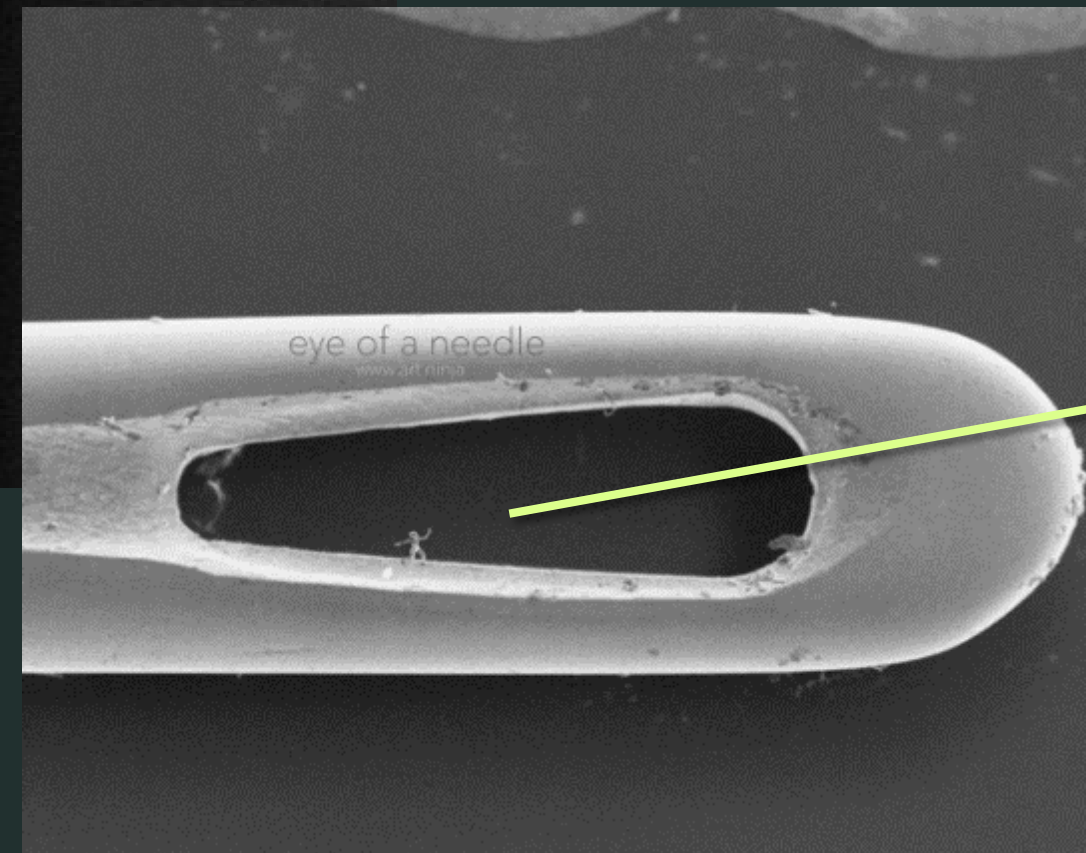
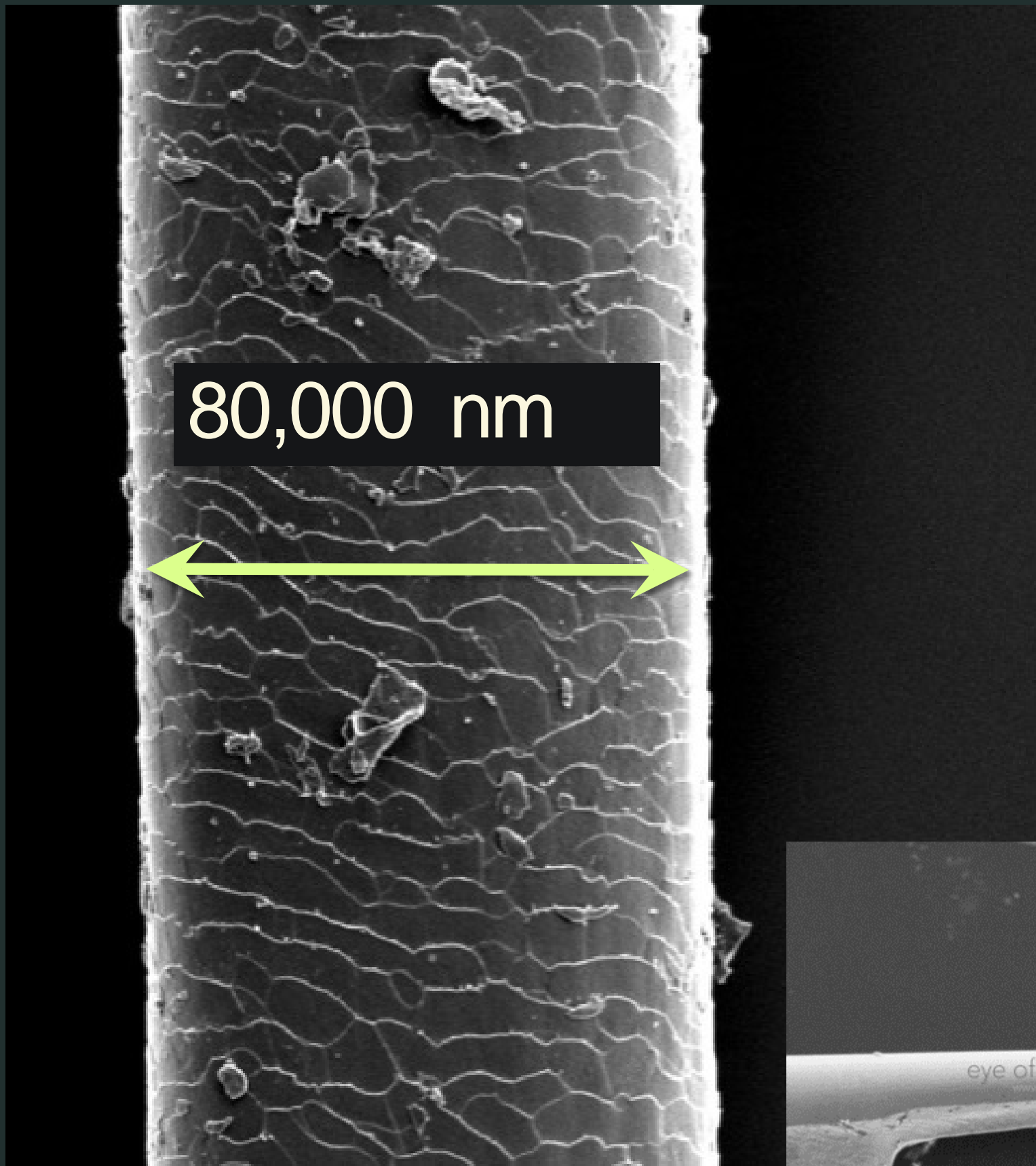


The fundamentals
The applications
Comparative advantage
How it works
Next level automation



What is a nanometer ?

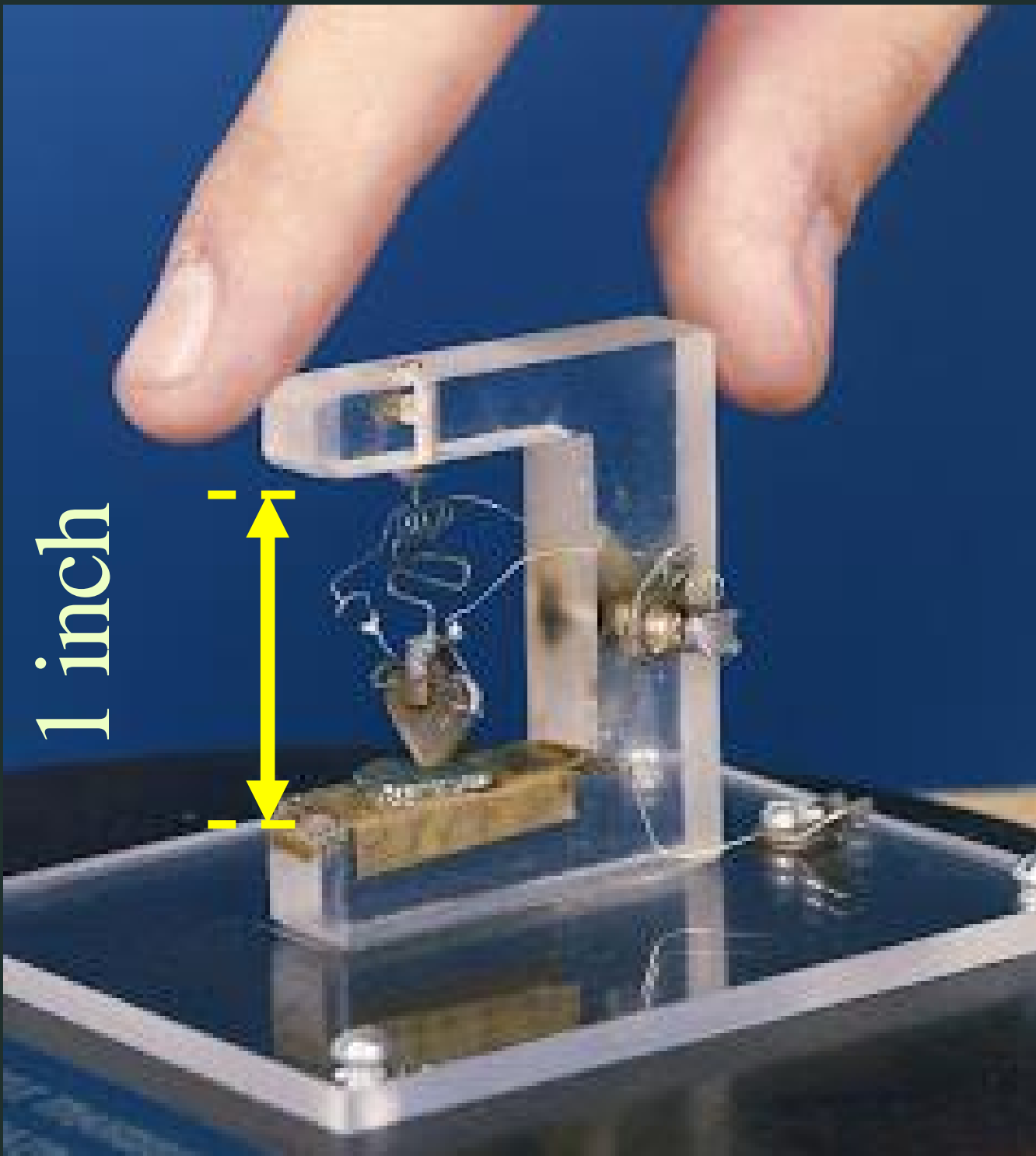
1 nm = 0.000000001 meters





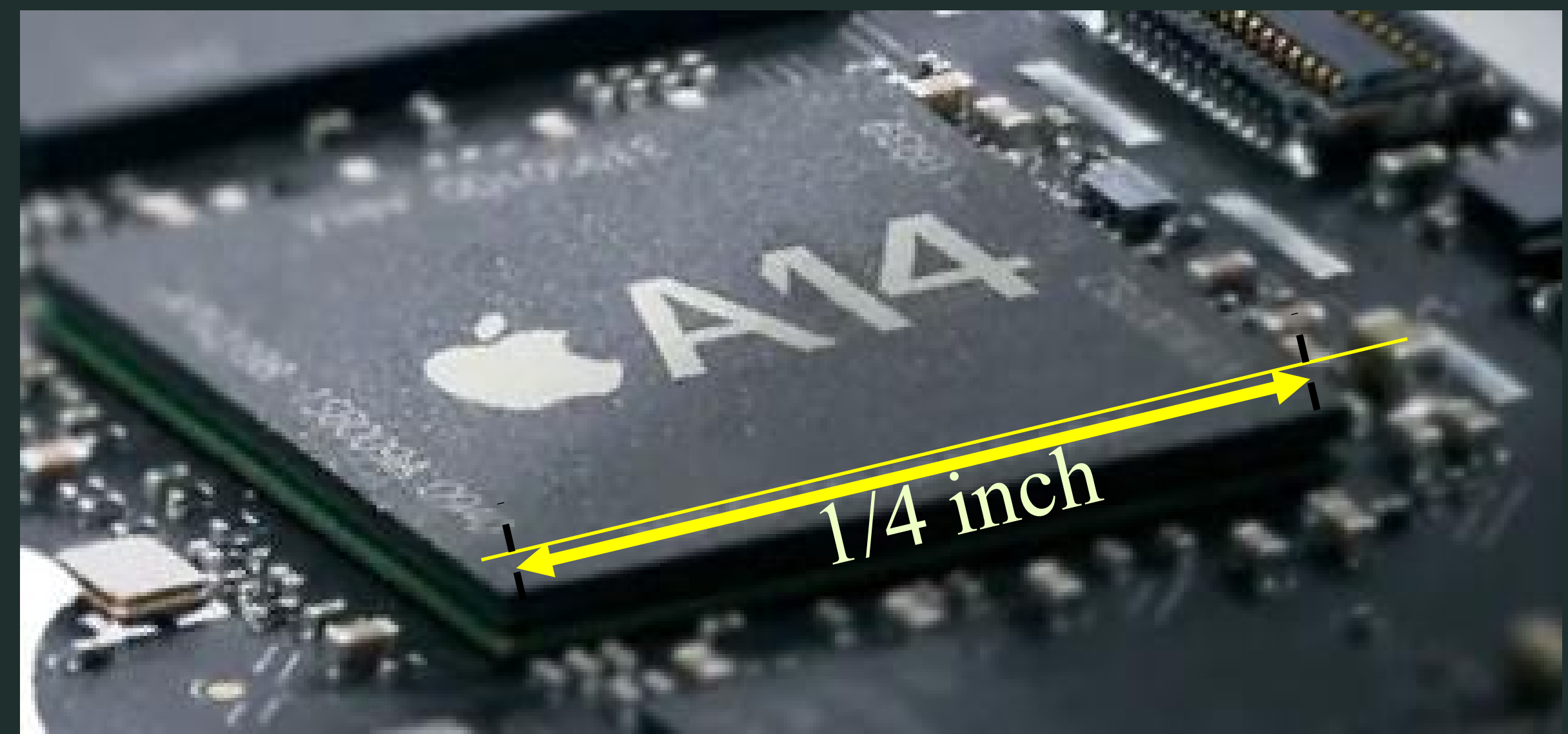
Small means fast: electronic chips automation analogy

1 transistor
1 bit: (0, 1)



1947

11.8 billion transistors
4 full human genomes/s



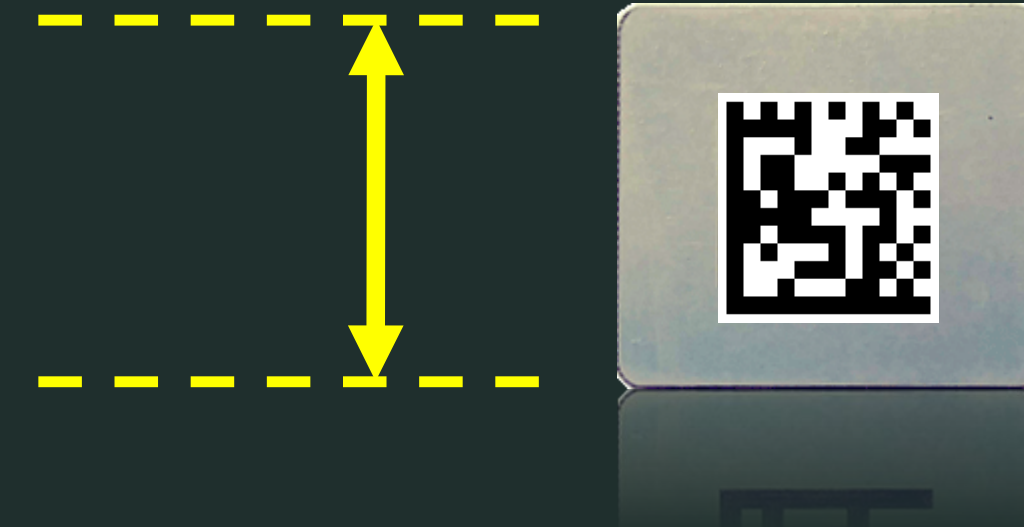
2020



Scale of DNA Automation: Present and Future

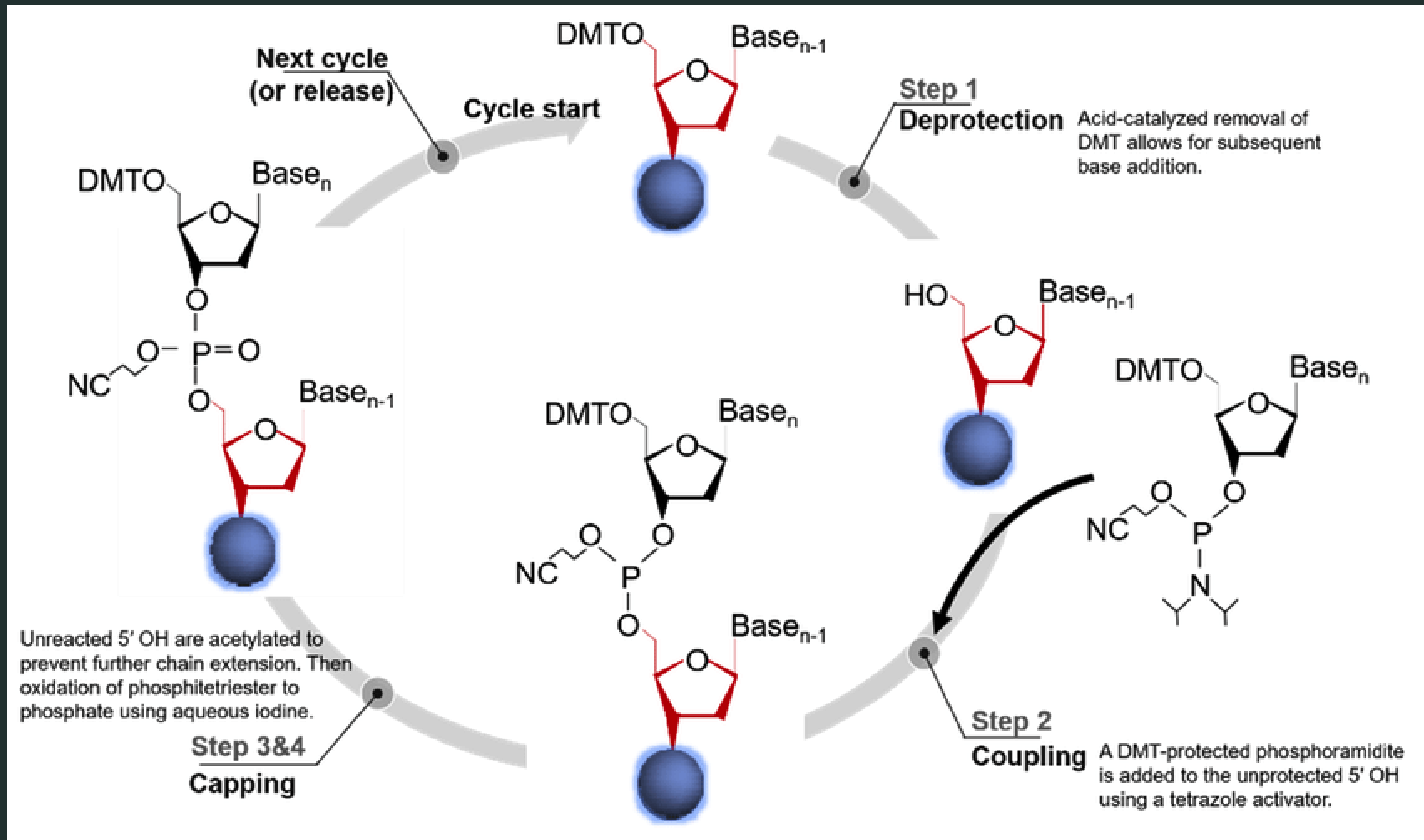


1/16 inch



Controlled Pore Glass 1934
column: 1 oligo
microplate: 726 oligos
scale: 1 micro mole

DNAREax™ 2021
chip: 1 oligo
plate: 180,000 oligos
scale: 1.8 micro mole

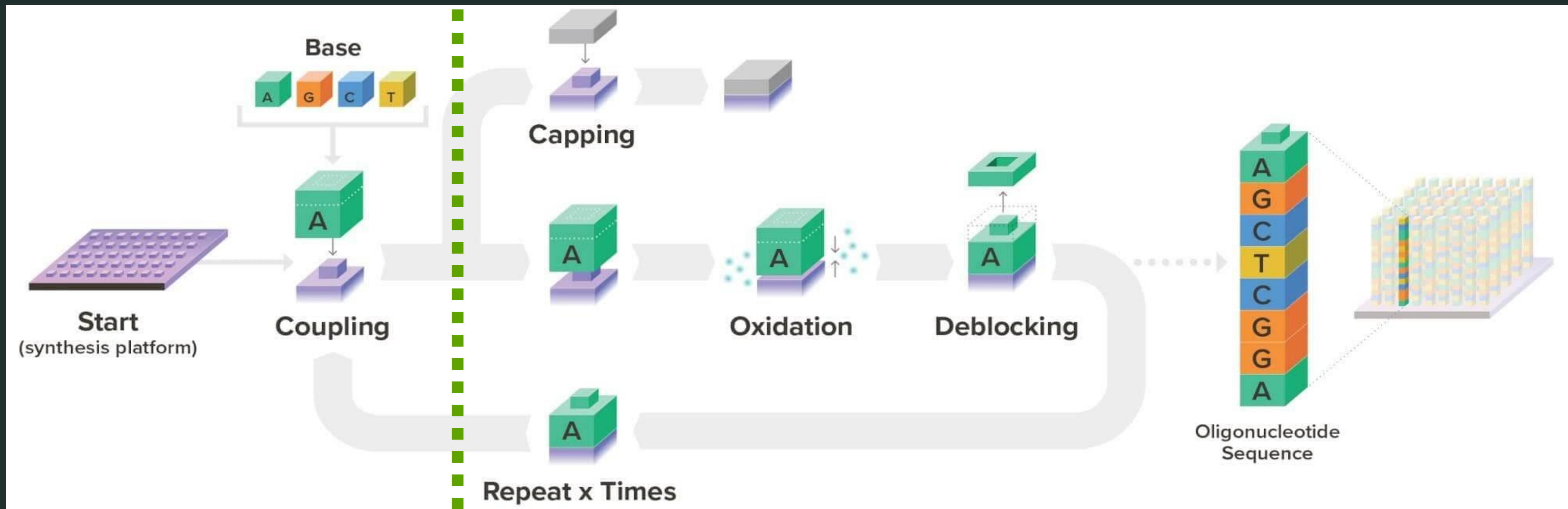




Simplified Workflow

platform

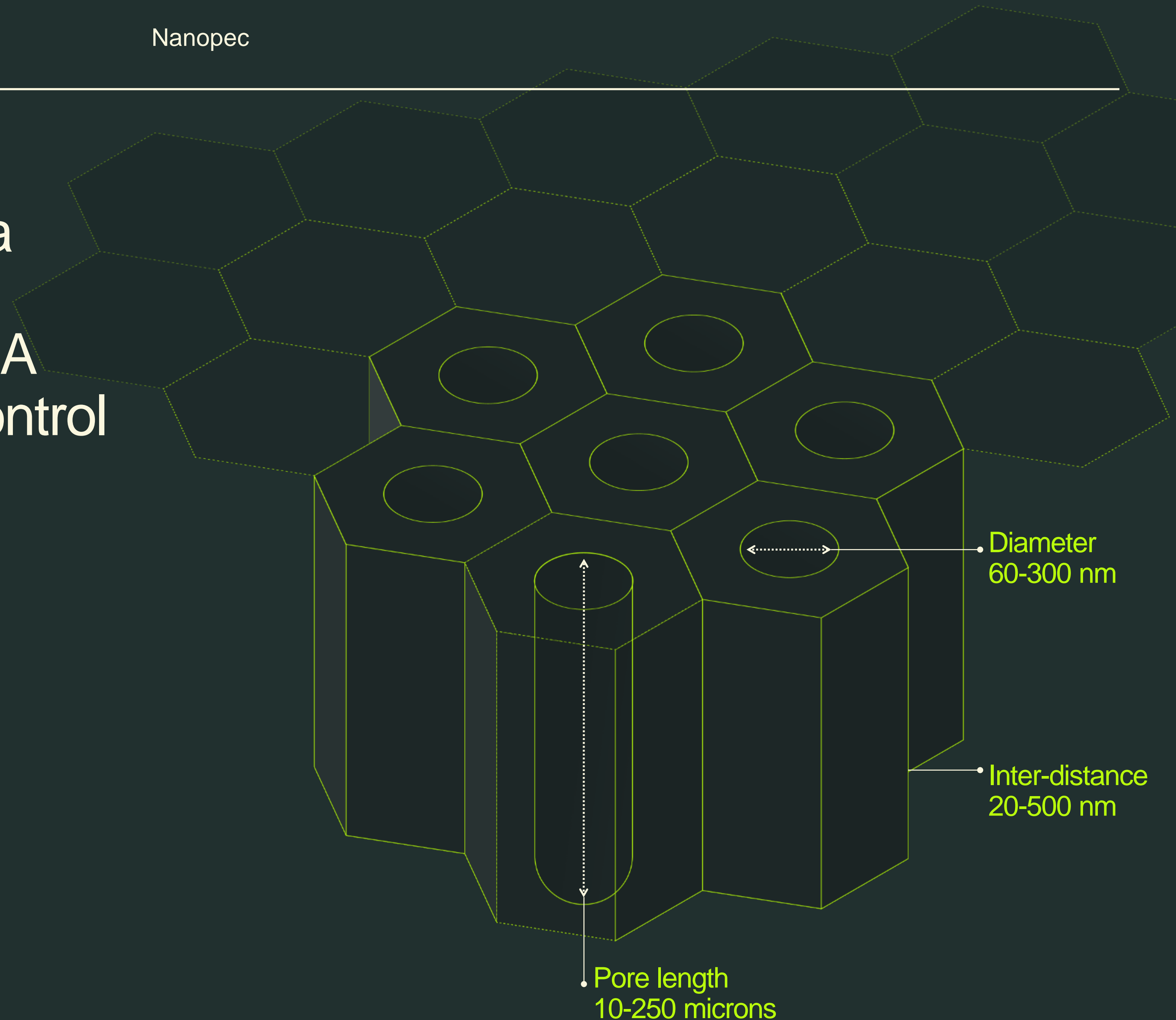
customer





The core of the technology is a patented nanoporous ceramic enabling precise DNA and RNA synthesis through pore size control

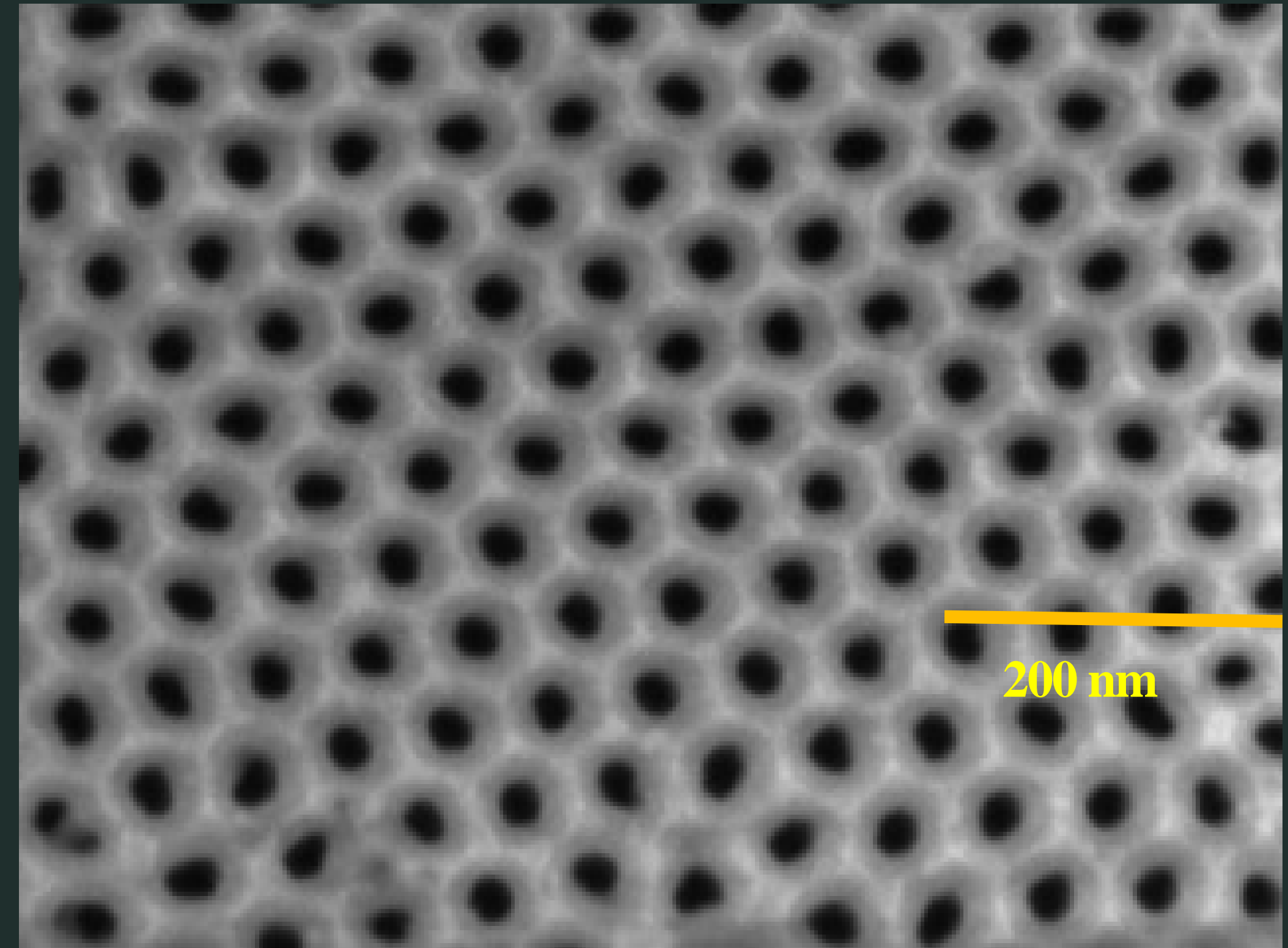
- Pore diameter
- Pore length
- Controlled surface spacing
- Patented DNA automation platform





DNAReax™ can transform the synthetic biology market

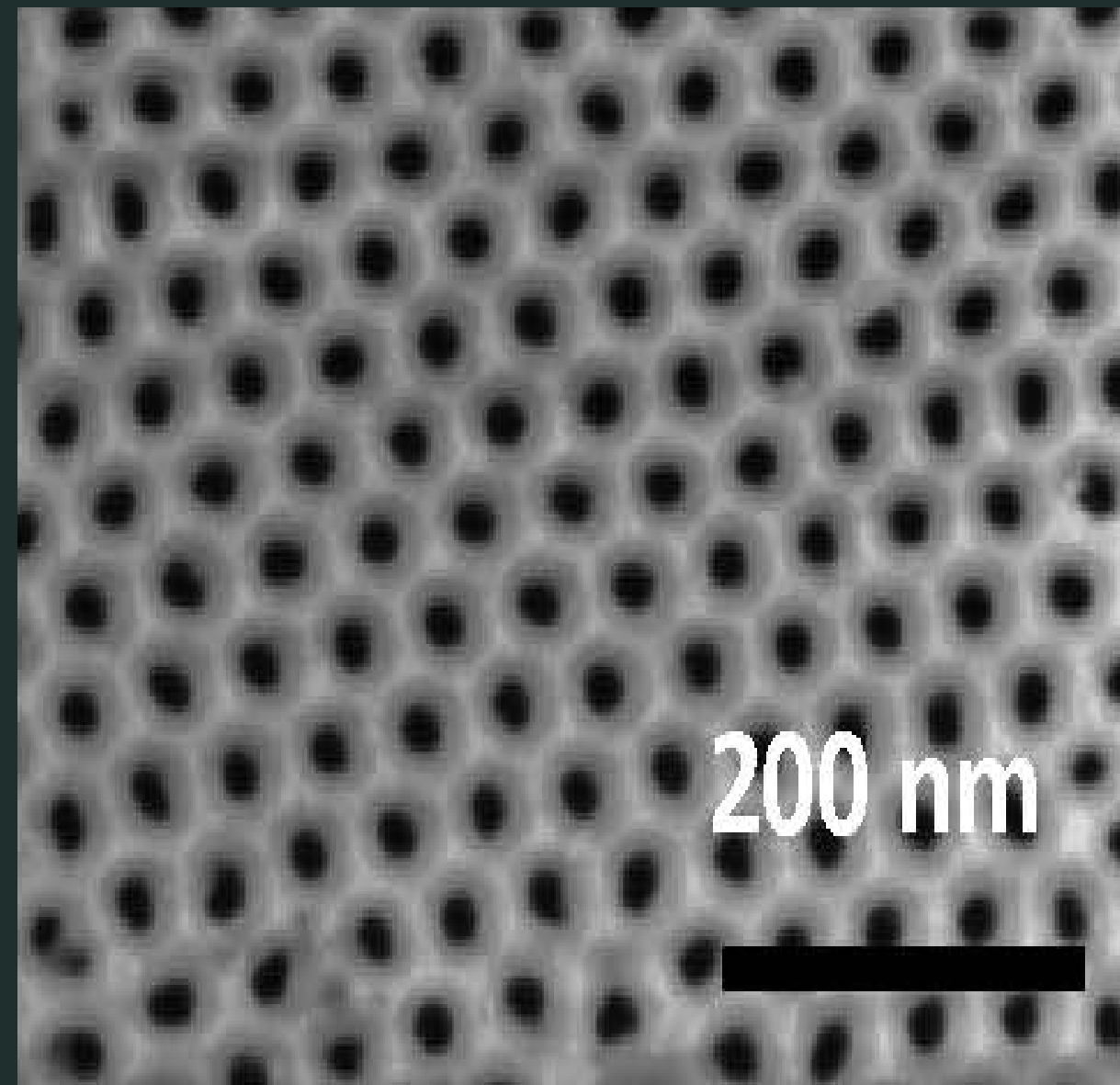
- ✓ Market ready technology
- ✓ Customer tested with high performance
- ✓ Low cost and scalable in-house production
- ✓ Patented DNA automation platform



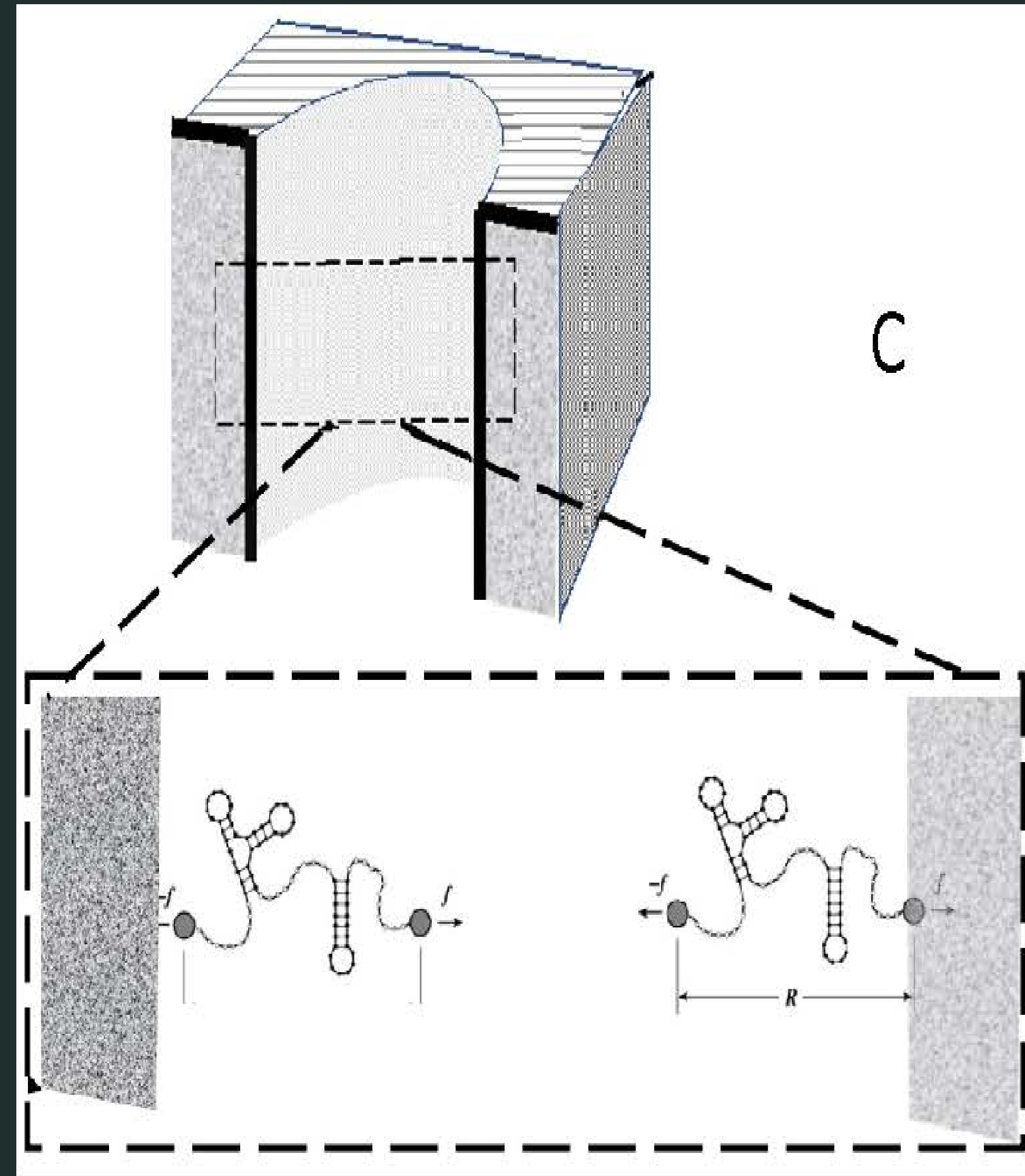
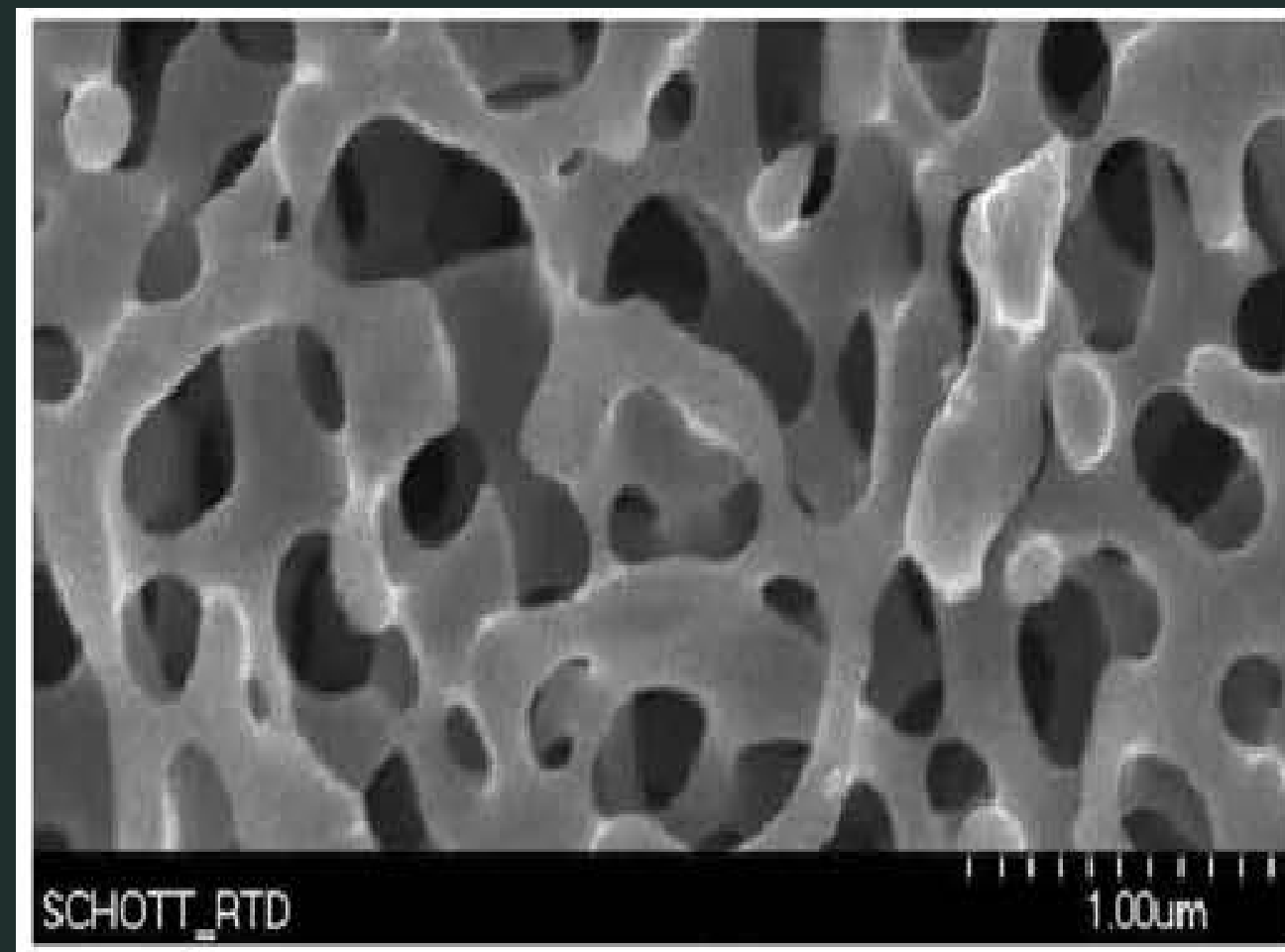


Nanostructured Ceramic vs CPG

A



B





Questions?

Customer case: DNA banking

One of the world's largest gene banks is already using DNAREax™

- Synthesizers handling 8000 chips
- Making 200 gene variants overnight
- LOI signed, first orders placed

“We get 460 times the yield compared to silicon”*

*Only by changing consumables, i.e. no CAPEX





Competitive analysis: automation outperforms current technologies

Process	CPG	Silicon	DNAREax
Distinct DNA Pieces	1-726	10^6	$10^5 - 10^6$
Formats	3D Columns microplates	2D Chips	2D Chips & plates
Yield (moles)	10^{-3}	10^{-13}	10^{-9} to 10^{-3}
Coupling Efficiency	98-99%	98-99%	>99%
Typical Oligo Size (nt)	60	60	60-120
Chemical Initiation	Demanding	Demanding	Effortless
DNA Spacing Control	None	None	High Precision



* All Data provided by paying customers, independent laboratories
 ** Experimentally validated data, over 50 tests, available under NDA
 *** Proprietary controlled surface silanization



Current focus is on early adaptors and applications in biological therapeutics

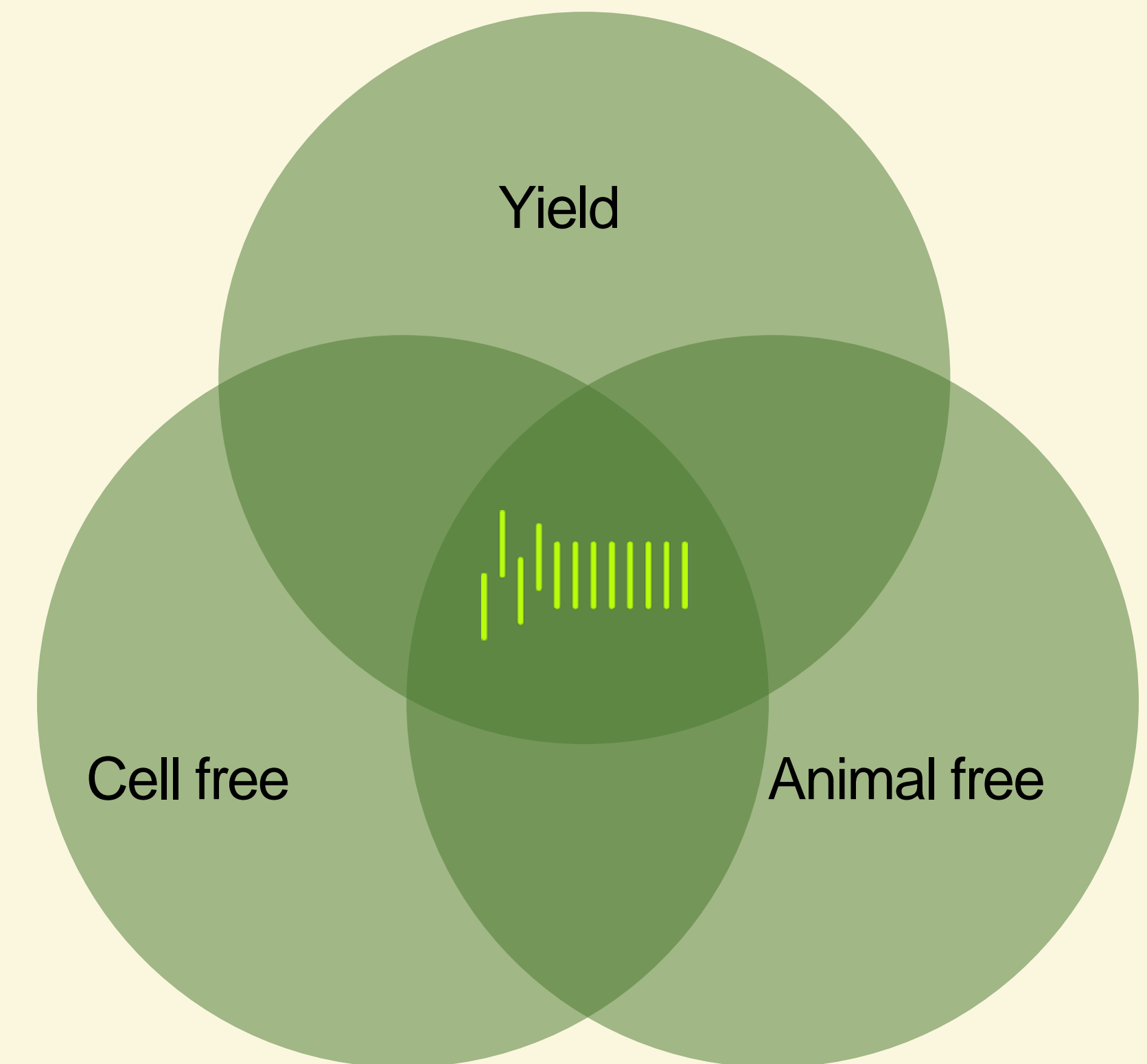
DNA banking

DNA Probes

Vaccines, DNA and RNA
based therapeutics

Platform is unique in being able to create pre-clinical amounts of cell free, animal free DNA overnight

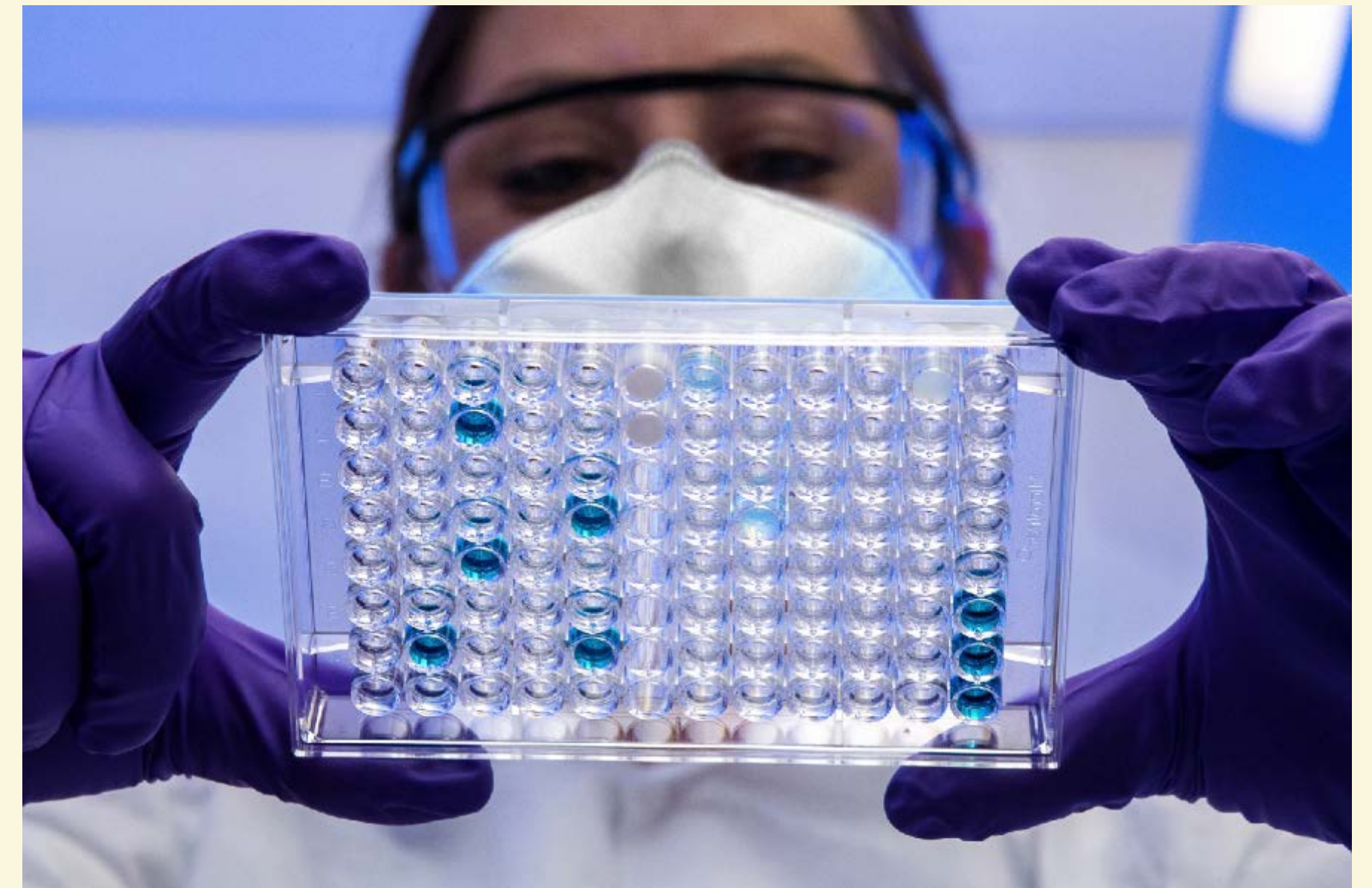
- No bovine serum, e-coli or mammalian cells
- No risk of cell/DNA contaminants leading to undesired immunological reactions
- Sufficient yields to run pre-clinical and clinical tests directly from synthesis, no fermentation or amplification needed





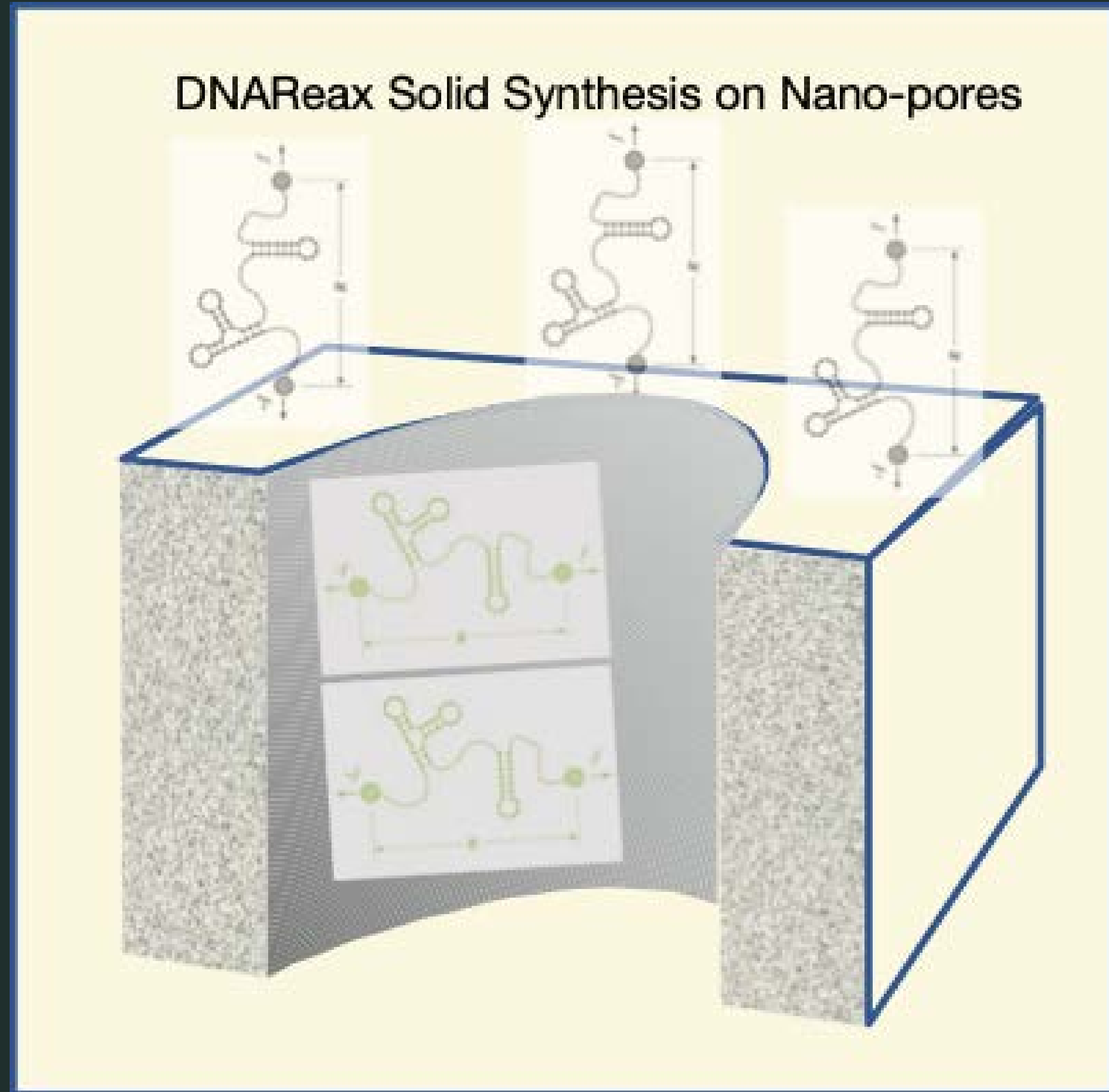
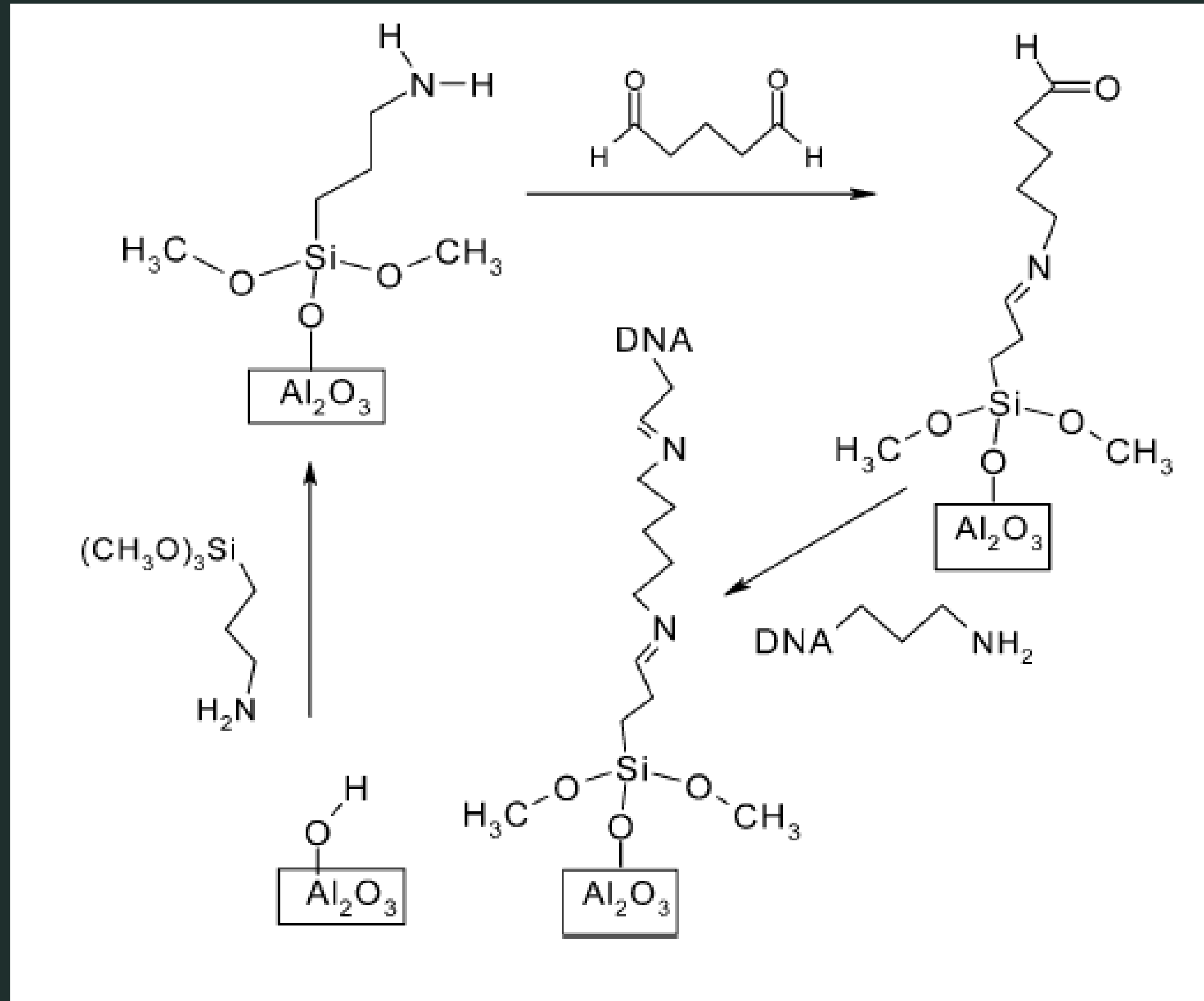
Collaboration with pharma client developing DNA based therapeutics

- Synthesis supply chain and timing is the number one issue for progress
- Standard lead time from external supplier is 6-8 weeks for one gene
- Sufficient yields for required gene libraries and animal tests can be created on one 10x10 cm DNAREax™ substrate in one day





Proprietary DNA Spacing on Nano-porous Substrate





nanopec protects IP: combination of patents and trade secrets

Blanco, M.; “Nano-porous anodic aluminum oxide membrane for healthcare and biotechnology”, US20200392639A1, WO/2020/257092 (Granted)

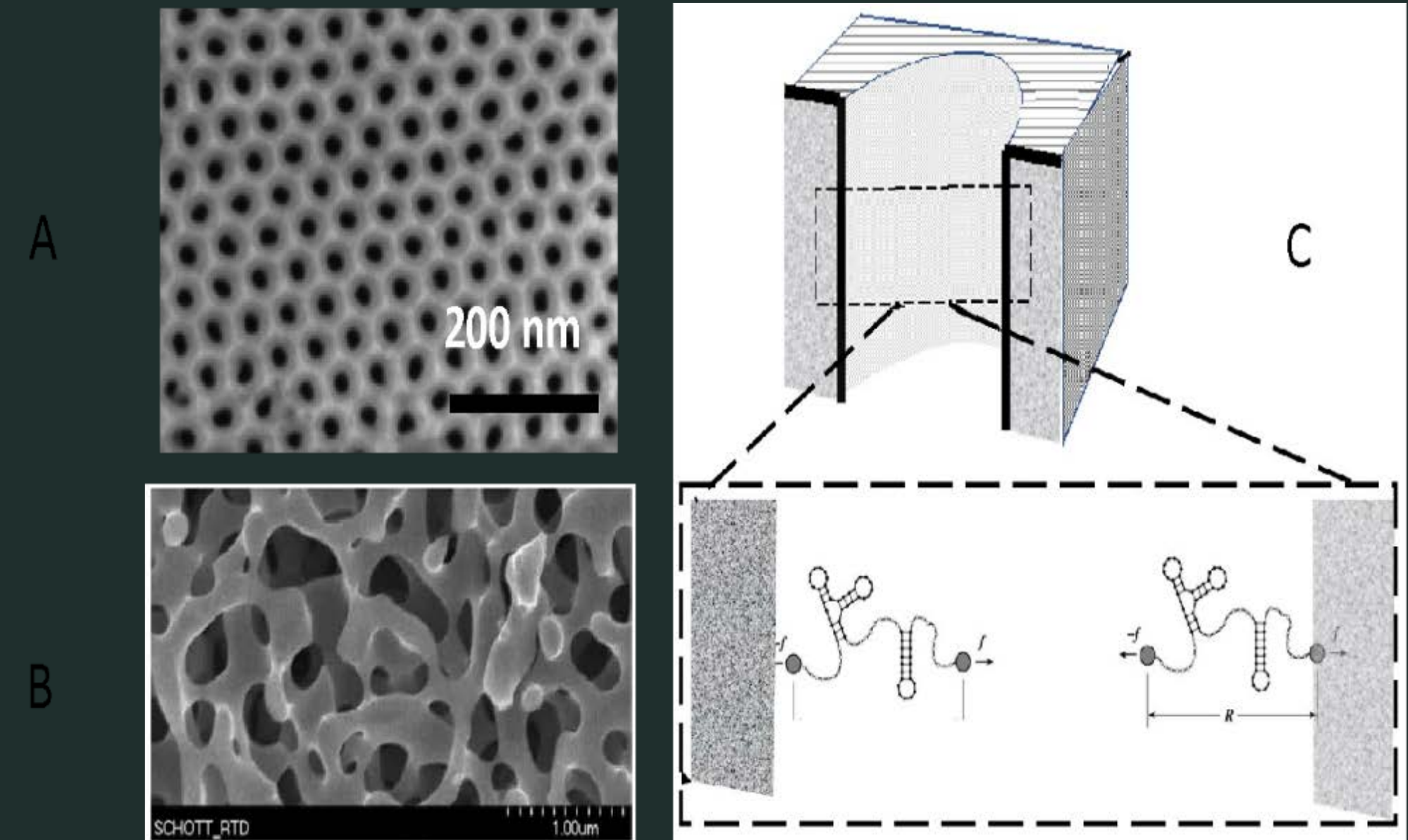
Blanco, M.; “Controlled Doping of Anodic Aluminum Oxide For Enhanced Fluorescence and Methods of Preparation”, US16799169 Application

Blanco, M.; “Enhanced signal to noise ratios for PCR testing within a FRET doped nano-structured ceramic film”, US63010268 Application

“Nano-structured Aluminum Oxide Ceramic Chips for the Automation of Solid-State Oligonucleotide Synthesis”, PCT 63183723 Application

Blanco, M.; “Doped Nano-porous ceramic films for high density bioassays”, PCT 63040245

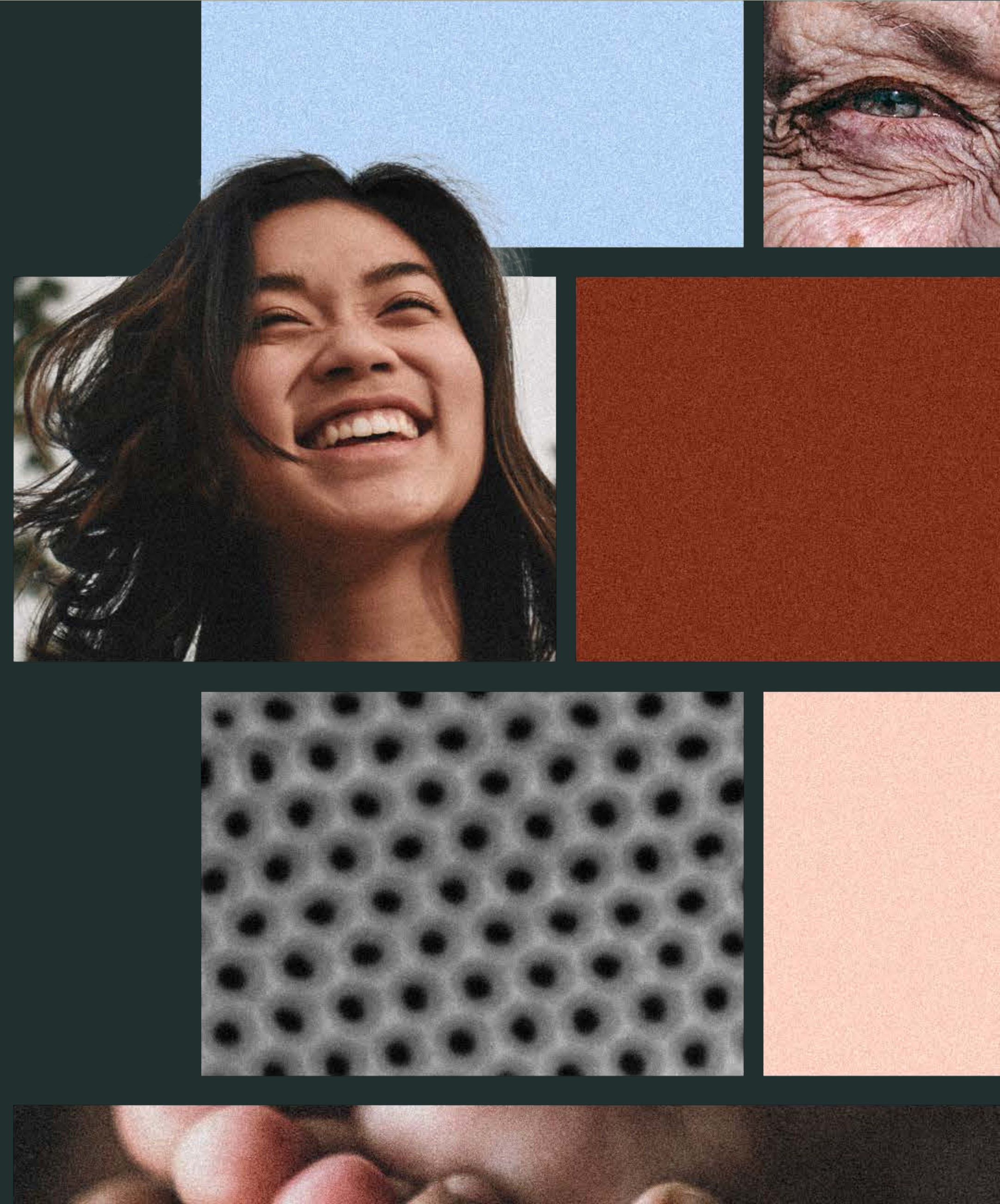
Blanco, M.; Ooppelstrup, N.; Apparatus And Processes For High Throughput Automation Of Synthetic DNA And RNA on Nanostructured Ceramic Films, U.S. Provisional Application No. 63354727



Patent: All inventions that can be reversed engineered are patented
Trade Secret: Otherwise kept undisclosed



Thank you!





Questions?