

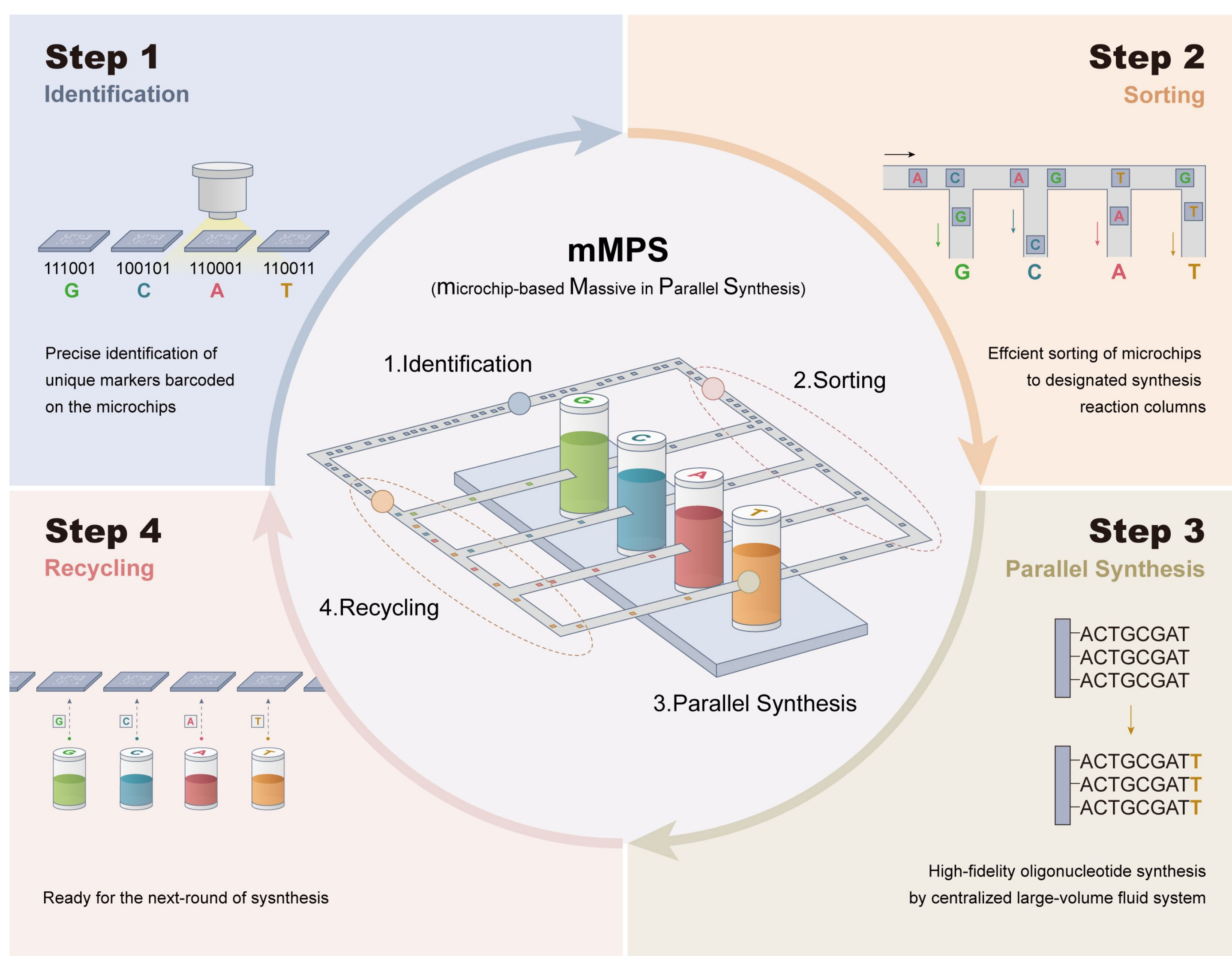
# Scaling DNA Synthesis Enhances Gene Synthesis and DNA Variant Library Generation

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## 1 Abstract

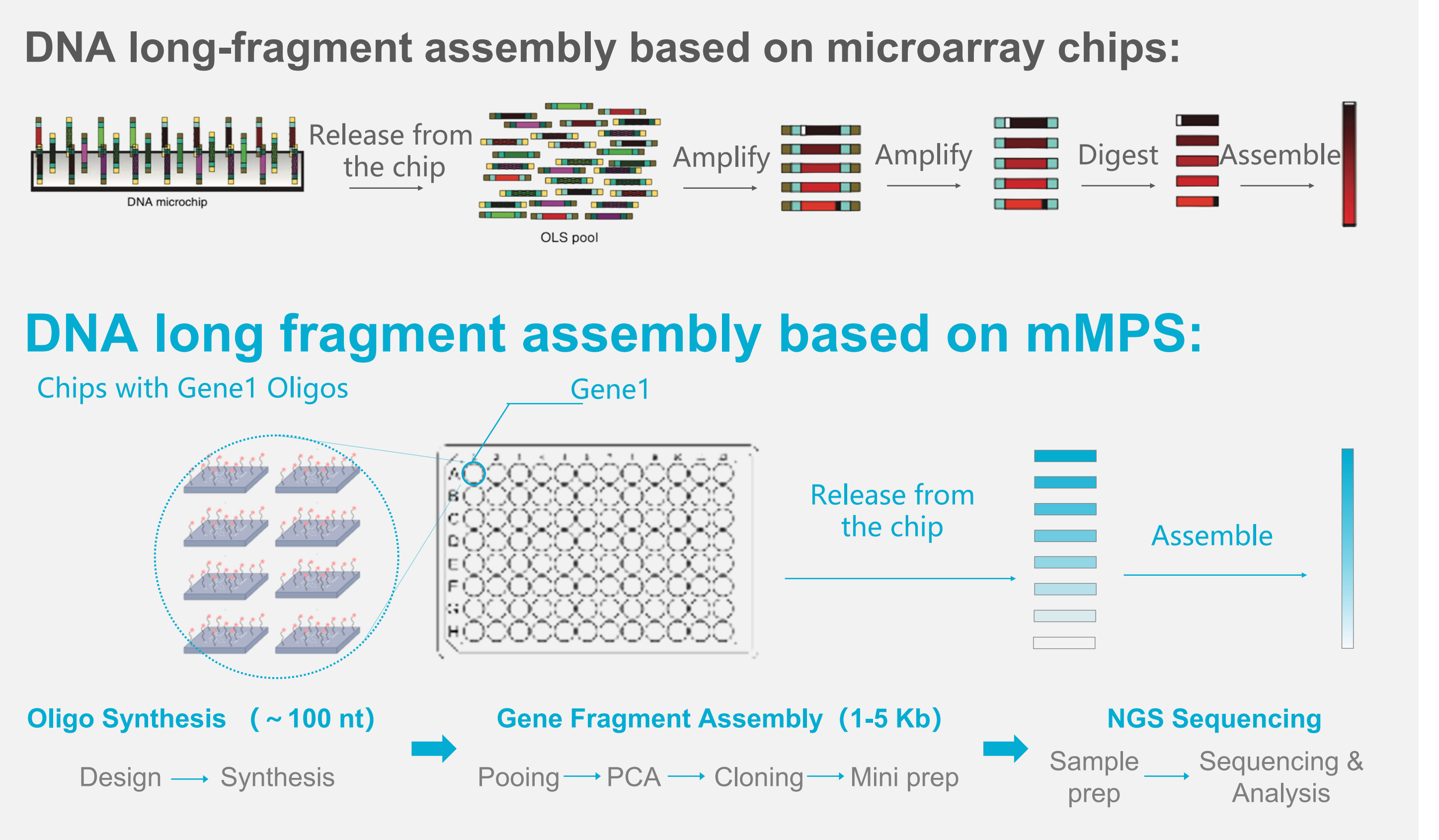
Conventional high-throughput (HTP) DNA synthesis technologies use intricate chip and microfluidic systems to produce large-scale synthetic oligonucleotides, which depend on chip manufacturing and complex microfluidic systems, but with low yield and limited compatibility for long DNA assembly. Here we highlight the microchip-based massive in parallel synthesis (mMPS) system, with an “identification–sorting–synthesis–recycling” iteration mechanism applied to microchips for high-throughput DNA synthesis. This achieves not only high-throughput but also offers higher yield and enhanced quality stability compared to conventional methods. We further explore its broad impact on downstream applications, particularly in high-throughput gene synthesis and DNA variant library generation.

## 2 mMPS HTP DNA Synthesis Technology

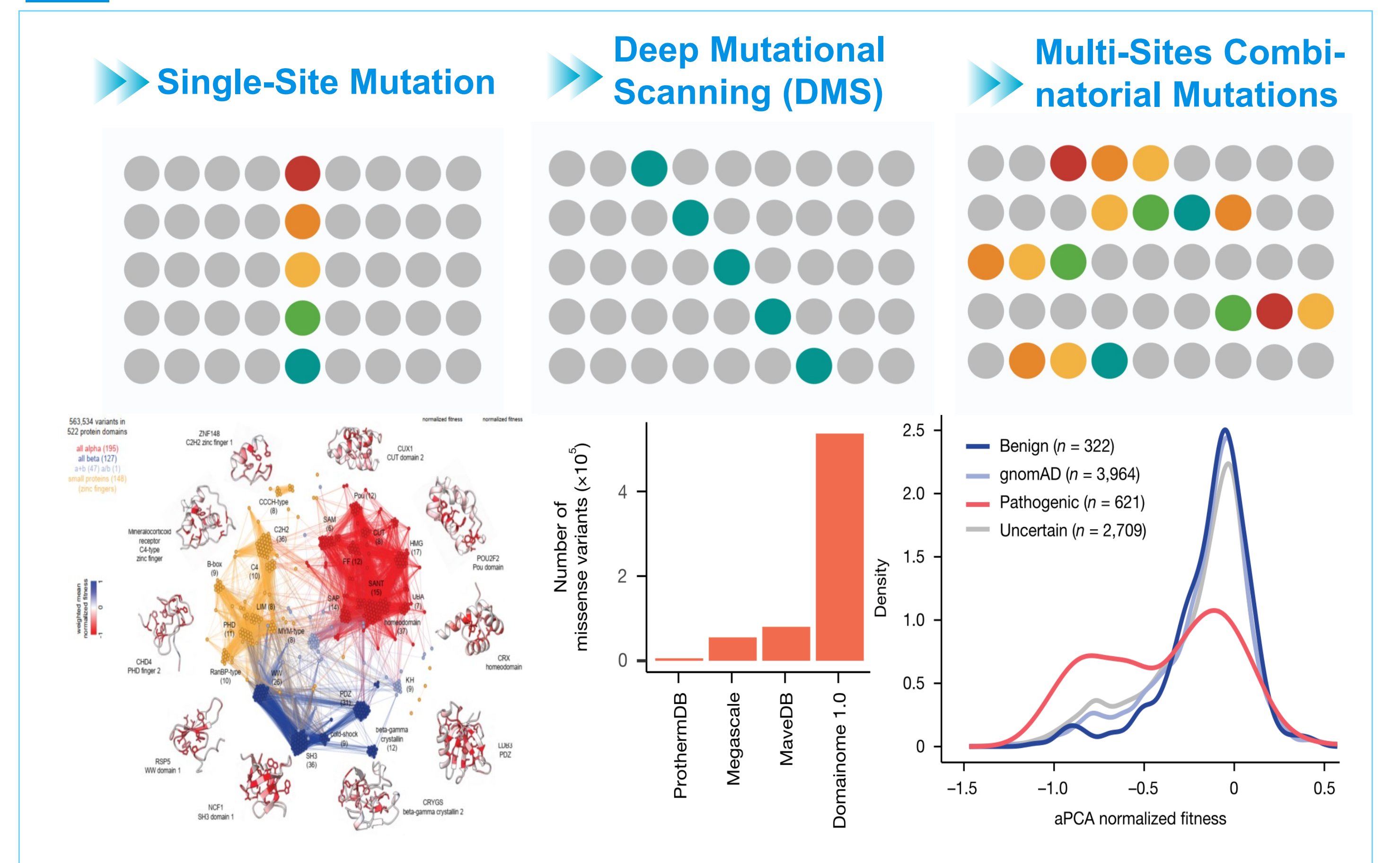


	Electrochemical	Inkjet-printing	mMPS
Support	Microarray chip	Microarray chip	QR code microchip
Throughput	48,000 - 90,000	10 <sup>6</sup>	10 <sup>5</sup> - 10 <sup>6</sup>
Yield	< 1 fmol	fmol	pmol - nmol
Efficiency	~97%	~98%	~99%
Error rate	5-8‰	3-5‰	~3‰

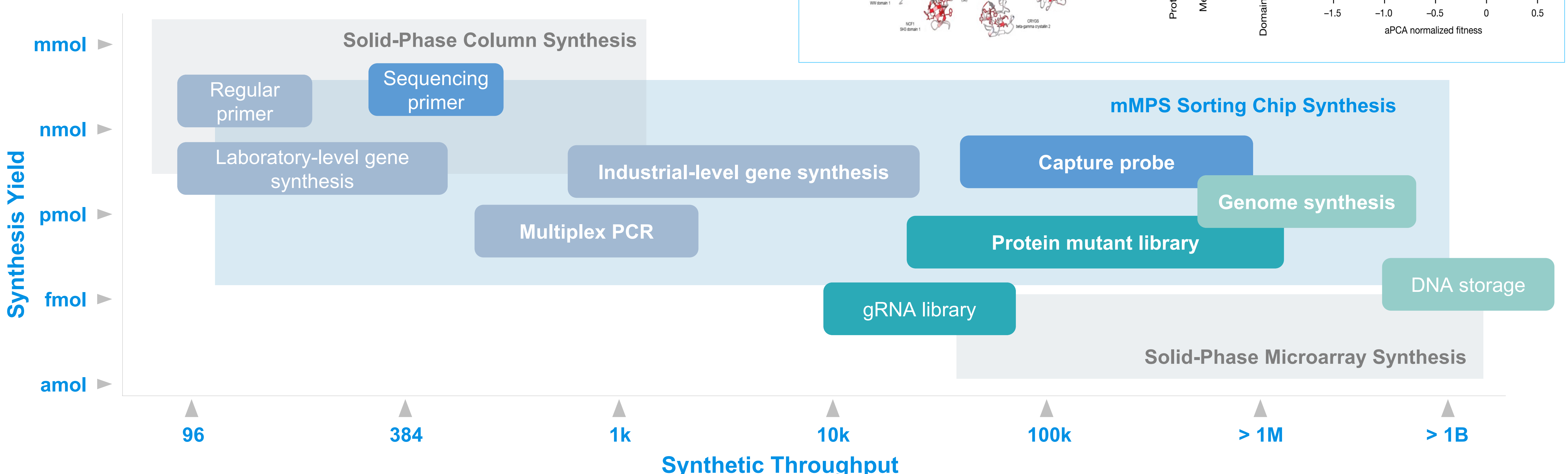
## 3 High-throughput Gene Synthesis



## 4 DNA Variant Libraries Generation



## 5 Diverse Applications



Zhang, et al. *Nature biotechnology*, 2025  
 Beltran, et al. *Nature*, 2025