Bioelectronica

APPLICATION NOTE

Hypercell Revolutionizes Diagnostic Kits Development

Accelerating Optimal Capture-Detection Antibody Pairs Discovery

Introduction: Why Antibody Pairs Matter

In today's rapidly evolving in vitro diagnostics market, the quality of your antibody pairs directly determines your competitive edge. When a sandwich assay employs perfectly matched, non-interfering antibodies, it delivers what matters most: superior sensitivity, exceptional specificity, and consistent reproducibility — all critical factors for accurate clinical results.

The Hypercell Platform
HT Single Cell Sorting

Yet most diagnostics companies still struggle with traditional antibody pair development pipelines that are:

- Painfully slow
  6-8 months from concept to validated pairs
- Resource-intensive
  requiring large teams and substantial budgets
- Unpredictable in outcomes
  with success rates hovering around 30%

This technological bottleneck has become the rate-limiting step in bringing innovative diagnostic solutions to market.

AbFinderAI Software
Antibody in Silico Analysis

Challenge: The Traditional Antibody Pair Development

The Conventional Workflow: Time-Consuming and Inefficient

Phase 1: Monoclonal Antibody Generation

- Animal immunization (8-12 weeks)
- Hybridoma creation and screening (4-6 weeks)
- Clone selection and expansion (3-4 weeks)
- Antibody purification and initial characterization (1-2 weeks)

Phase 2: Pair Screening and Optimization

- Orthogonal pairing matrix testing (2-4 weeks)
- Performance evaluation across key metrics (2-3 weeks)
- Manufacturing scale-up and consistency validation (3-4 weeks)

Result: A 6-8 month development timeline that delays product launches and consumes valuable R&D resources.

Key Limitations Creating Bottlenecks

Most diagnostics companies still struggle with traditional antibody pair development that:

- The Combinatorial Challenge
  With just 20 antibody candidates, you need to test 400 potential pairs
- Resource Constraints
  Limited capacity means many promising combinations go untested
- Epitope Coverage Gaps
  Traditional methods often miss critical binding regions
- Performance Trade-offs
  Optimizing for both sensitivity and specificity requires extensive iteration
- Risk of Settling
  Time pressure often leads to selecting "good enough" rather than optimal pair

The Hypercell Solution: Redefining Antibody Pair Discovery

The Breakthrough Technology Platform

Figure 1: One day workflow of Hypercell

Single-Cell Precision Combined with Massive Scale

- Encapsulate individual B cells in picoliter-scale reaction droplets
- Directly recover paired heavy and light chain sequences from positive hits

AI-Powered Bioinformatic Analysis with AbFinder

- Advanced sequence homology mapping identifies promising antibody families
- Structural prediction algorithms evaluate binding potential and stability
- Smart ranking system recommends optimal candidates for expression

Rapid Expression and Functional Validation

- Streamlined recombinant expression through Bioelectronica partnership service
- Preserve natural antibody pairings for optimal function
- Generate diverse antibody pool covering multiple epitopes

The Hypercell Advantage

	Traditional Methods	Hypercell Platform	Your Advantage
Development Timeline	6-8 months	6-8 weeks	75% time savings
Screening Capacity	Dozens of candidates	100s to 10,000s of candidates	10X-100X greater coverage
Success Rate	~30%	>70%	2.3X higher probability of success
Epitope Coverage	Limited by random chance	Comprehensive by design	Superior assay performance
Screening Time	Weeks of iterative testing	Single-day high-throughput analysis	Accelerated development cycles

Table 1: Performance comparison and key numbers

Case Study 1: High-Sensitivity Cardiac Marker Detection

The Challenge

A leading IVD company needed next-generation cardiac injury marker assays with substantially improved sensitivity—a critical advancement for earlier detection of cardiac events when interventions are most effective.

Hypercell Workflow

1. Sample Rapid Processing (~60min)

After optimized immunization yielding high-titer responses, we processed spleen cells and enriched plasma B cells in just 60 minutes.

2. Single Cell Encapsulation & Incubation (~60min)

500,000 enriched cells were encapsulated in our proprietary droplet system, establishing cluster-based screening with visual confirmation of positive signals.

3. Hypercell Precision Single-Cell Sorting (~90min)

Our system isolated cells showing high-affinity binding patterns, capturing rare high-performers that traditional methods typically miss.

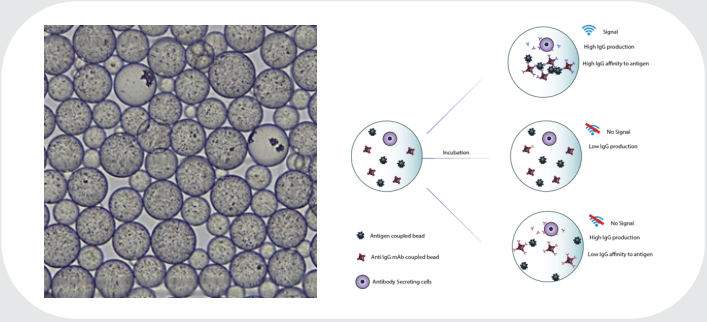


Figure 2: Hypercell Immuno-agglutination assay principle. Microscope (left) and schematic (right) images of cells and Hypercell reagents in droplets. Each single cell secretion assay takes place in a nanofluidic droplet called PODs (polydisperse oblate dispersion system).

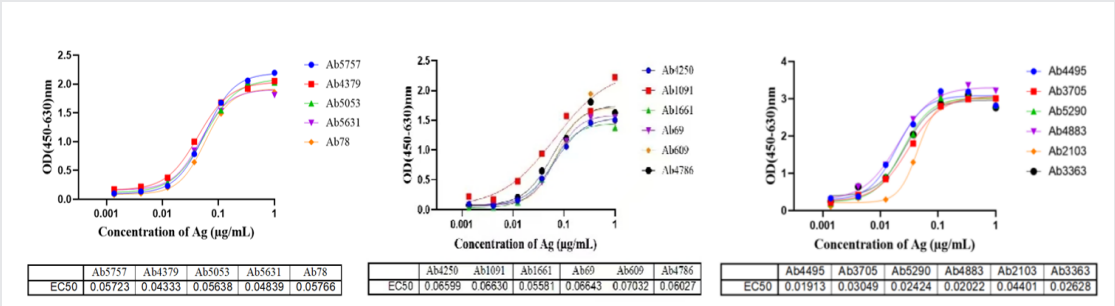
The circles with dark edges of various sizes are PODS

4. Comprehensive Single Cell Library Construction (<7 days)

Using next-generation 10X Chromium technology, we constructed and sequenced single B cell V(D)J libraries, yielding 5,819 antibody candidates.

5. AI-Guided Candidate Selection & Validation (< 21days)

Our AbFinderAI platform analyzed the entire dataset, clustering by sequence and predicted structure to identify 17 representative antibodies—all of which demonstrated strong antigen binding in validation tests.



	Ab5757	Ab4379	Ab5053	Ab5631	Ab78
EC50	0.05723	0.04333	0.05638	0.04839	0.05766

	Ab4250	Ab1091	Ab1661	Ab69	Ab609	Ab4786
EC50	0.06599	0.06630	0.05581	0.06643	0.07032	0.06027

	Ab4495	Ab3705	Ab5290	Ab4883	Ab2103	Ab3363
EC50	0.01913	0.03049	0.02424	0.02022	0.04401	0.02628

Figure 3: Affinity measurement of candidate antibodies

Results

- Through single-cell sequencing, multiple novel antibody gene sequences were successfully identified from sorted cells, native paired heavy and light chains perserved
- All expressed antibody candidates showed sub nM binding
- Optimal capture-detection pairs achieved the client's high-sensitivity targets
- Development timeline slashed from 6-12 months to less than 3 months

Case Study 2: Conquering HBsAg Variant Detection

The Challenge

A diagnostic company needed to develop comprehensive HBsAg detection kits capable of identifying multiple variant strains across global markets—a critical need given that HBV mutations frequently lead to false-negative results in standard assays.

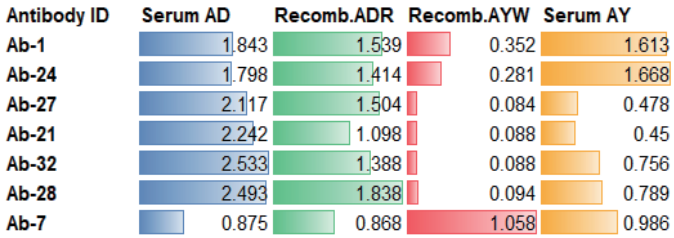
Hypercell Approach

1. We supported the client's dual-species immunization strategy targeting both conserved and variable epitopes

2. Conducted four parallel screening rounds using mouse and rabbit B cells

3. Generated a massive selection pool of 8,612 antibody candidates in just two weeks

4. Used AI-powered AbFinder analysis to identify the most promising 69 antibodies for expression and validation.



Antibody ID	Serum AD	Recomb.ADR	Recomb.AYW	Serum AY
Ab-1	1.843	1.539	0.352	1.613
Ab-24	1.798	1.414	0.281	1.668
Ab-27	2.117	1.504	0.084	0.478
Ab-21	2.242	1.098	0.088	0.45
Ab-32	2.533	1.388	0.088	0.756
Ab-28	2.493	1.838	0.094	0.789
Ab-7	0.875	0.868	1.058	0.986

Figure 4: Seleted antibodies panel for kit development

Results

- Successfully developed antibodies targeting both conserved regions and variant-specific epitopes
- Created a comprehensive panel covering multiple geographic subtypes
- Enabled the client to launch region-specific diagnostic products worldwide

Your Path to Superior Antibody Pairs

The development of exceptional antibody pairs is no longer a bottleneck but an opportunity for competitive advantage. With the Hypercell platform, you can:

- **Accelerate Development:** Cut your timeline by 75%, getting to market faster
- **Improve Performance:** Discover truly optimal pairs, not just acceptable ones
- **Reduce Risk:** Increase success probability from 30% to over 70%

Contact our scientific team to discover how Hypercell can deliver breakthrough antibody pairs for your next diagnostic innovation.

www.bioelectronica.com

LinkedIn

Contact us

Bioelectronica Holdings Inc.
www.bioelectronica.com
Email: hello@bioelectronica.com