



Symyx Technologies, Inc.



Symyx®

DOE Workshop

**HIGH THROUGHPUT/COMBINATORIAL SCREENING
OF HYDROGEN STORAGE MATERIALS**

June 26, 2007

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Symyx Technologies

Symyx develops and applies proprietary **high-throughput research technologies** and **software** to increase R&D efficiency in chemical, energy, electronics, pharmaceutical and academic labs.

- Pioneer of High Throughput Research (HTR) for materials science
- Founded in 1996; publicly traded since 1999 (SMMX: NASDAQ)
- 400 Employees (mainly in Santa Clara, CA)
- >\$400 million invested in technology development over 11 years
- 340 issued patents and 185 pending applications covering broad range of applications and technologies



Representative Customers

Pharma & Biotech:



Chemical & Energy:

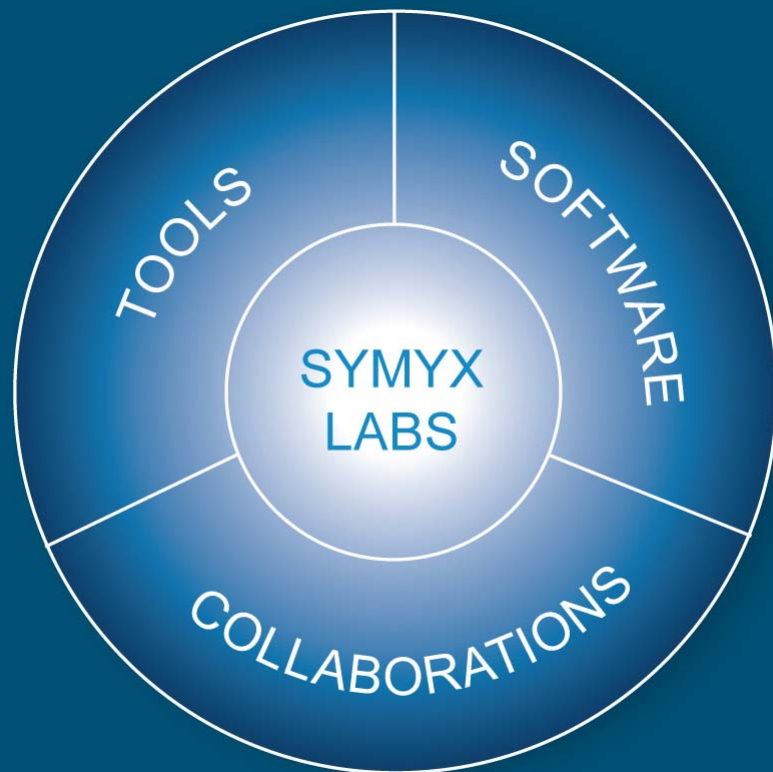


Consumer/Other:

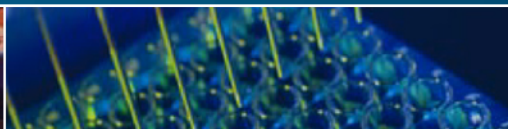


Academic:

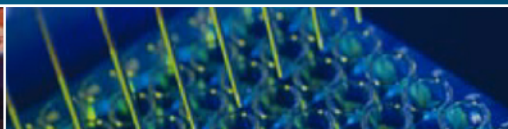
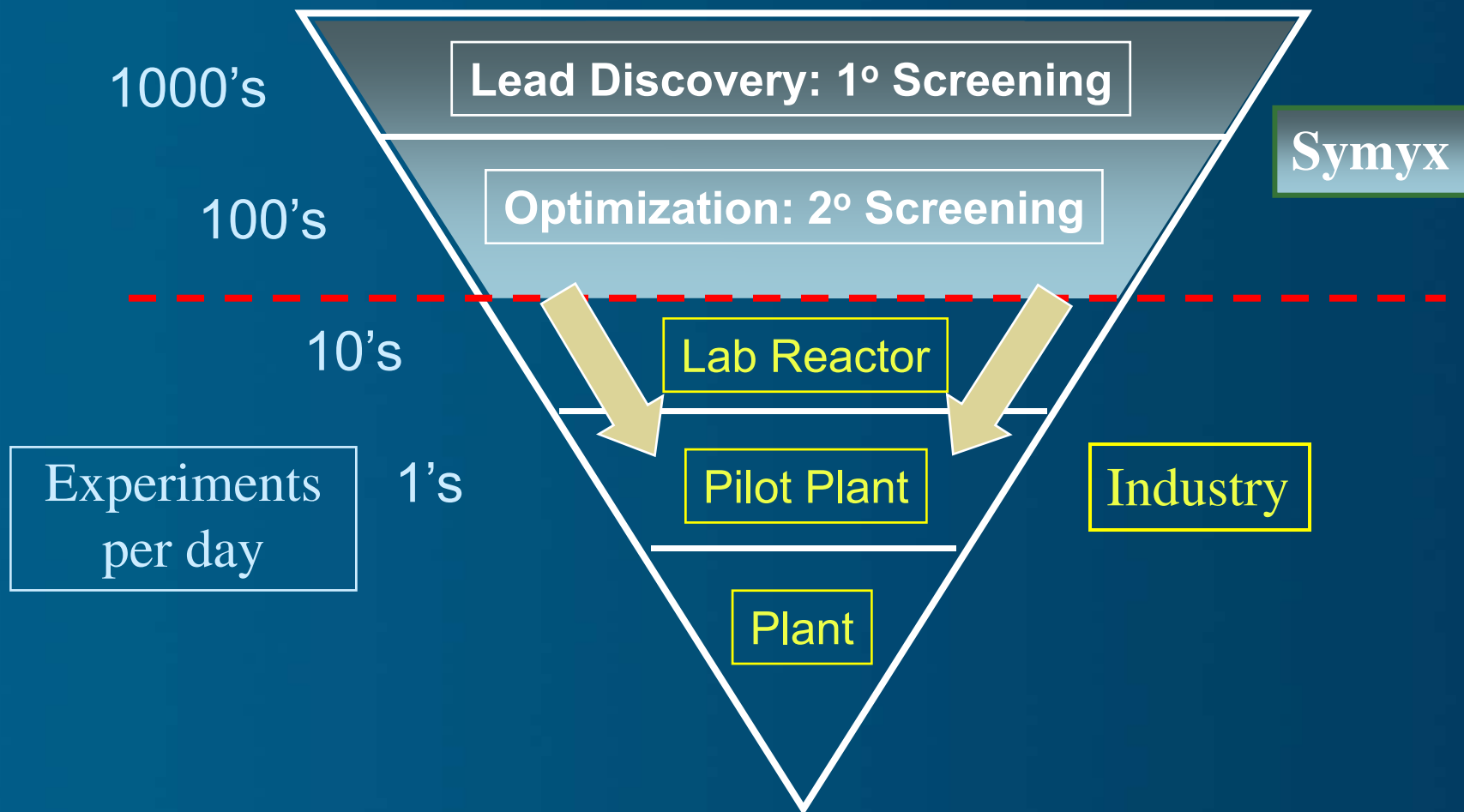




- Funded **Research Collaborations** for new technology development
- **Symyx Software** to manage research data and integrate R&D teams
- **Symyx Tools** to increase research productivity



Primary and Secondary Screening



Platform Technology Areas

- **Homogeneous Catalysis**

- Ligand Synthesis
- Catalyst Synthesis
- Parallel Reactor Technology
- HT Polymer Characterization

- **Heterogeneous Catalysis**

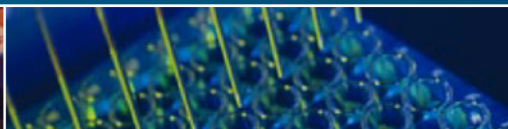
- Substrate Synthesis
- Catalyst Preparation
- Parallel Reactor Technology
- HT Product Characterization

- **Specialty Polymers**

- Monomer, Initiator, Control Agent Syntheses (Organic)
- Parallel Reactor Technology
- HT Polymer Physical/Materials Properties Characterization

- **Optical/Electronic Materials**

- Vapor Phase Thin-Film Synthesis
- Solution Phase Library Synthesis
- HT Materials Characterization
- HT Device Fabrication and Performance Evaluation



Materials Classes Studied at Symyx

Energy Storage and Generation

batteries, fuel cell electrodes, thermoelectrics, photovoltaics

Optical Materials

photo- and electroluminescent phosphors for lighting/displays, materials for digital radiography, inorganic and organic OLEDs, TCOs

Electronics Applications

semiconductors, dielectrics, diffusion barriers, magnetics, electroless metals and metal alloys, photoresists

Heterogeneous Catalysis

mixed-metal oxides/sulfides, zeolites/mesoporous oxides, supported oxides, sulfides, clays

Homogeneous Catalysis

organic ligands, inorganic and organometallic complexes



Materials for Hydrogen Storage

Materials Classes Relevant to H₂ Storage

- High surface area organic and inorganic materials
- MOFs (Jeff Long)
- Nano-scale materials
- Complex metal hydrides
- Chemical hydrides (B, C, N)
- Homogeneous and heterogeneous catalysts for H₂ uptake/release

Required HT Technology

- Automated, array-based materials synthesis platforms
- General materials properties analysis
- Reactors for direct H₂ uptake/release



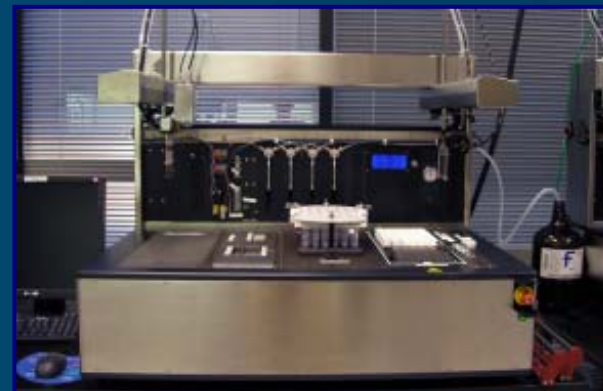
Heterogeneous Catalysis: Synthesis



Precursor preparation



Support dispensing



Parallel/rapid serial Impregnation



Wash



Reduce, sulfide, etc.



Solid Transfer

Transfer to reactor vessel
by weight or volume, may
dilute

Characterization

(e.g. XRD, BET, EDS,
microscopy)



Symyx Tools and Software

