



Cellular Imaging and Image Analysis: A Market Update

Biocompare Surveys and Reports

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Report Introduction

The 2005 Cellular Imaging and Imaging Analysis Report comprises an overview of the microscopy and imaging market, an introduction to the 2005 Cellular Imaging and Imaging Analysis Survey, a comprehensive discussion of the survey findings, and conclusions and recommendations that are drawn from both market analyses and survey data gathered from researchers who perform microscopy and imaging analysis in their research. The Market Overview delves into the trends of imaging technologies as they relate to sales and advances within the imaging arena. Many industries are both interested and invested in understanding the cell on a microscopic level, which has continued to fuel sales of imaging equipment and software. The field is predicted to maintain an average growth rate of 11% over the next 4-5 years, with significant increases in electron and confocal microscopy overall. Confocal imaging, which provides images superior in quality to light microscopy, is additionally buoyed by popular high-throughput protocols and improved strategies in drug development and clinical diagnostics. Sales of such automated confocal systems are expected to double by 2008, yielding a 23% growth rate and contributing to the upsurge in imaging revenues. The goals and methodology of the 2005 Cellular Imaging and Imaging Analysis Survey are outlined in the Survey Introduction, with important findings from each survey question described in the Discussion of Results. As it comprises the bulk of this report, this section focuses on the specific tools, reagents, and imaging systems in use, their current and desired applications, and software products that drive the imaging market. Additionally, key differences from the 2004 Cellular Imaging Report are emphasized. Overall conclusions and recommendations regarding the current cellular imaging market are provided in the final report section, which blends market trends with the survey data. Finally, the detailed survey questionnaire, data, and tabulated results are presented in the appendices.

Market Overview

Microscopes and other imaging devices are riding an upsurge in sales from various industries that thrive on grasping the details of molecules and sub-molecular particles. By developing sophisticated devices, academia and manufacturers provide the power required to visualize and understand the microscopic world. A major impetus for the continued advancement in imaging technologies is the push to probe ever deeper into the inner-workings of the cell. These efforts, along with those in other industries, will continue to fuel sales of imaging equipment.

While life science research has traditionally made up the largest customer base for imaging equipment, other industries are quickly catching up. In 2003, the life sciences made up 28% of all customers, according to "Microscopy Markets," published by Trimark Publications¹. The semi-conductor and materials science industries each made up 25% of customers. Nanotechnology research required enough imaging equipment to represent 11% of customers. The Trimark reports that efforts semi-conductor manufacturing and nanotechnology make these two areas the two fastest growing sources of customers. The average annual growth rate of customers in semiconductors is 14%. In nanotechnology, the rate is 20%.

"The need for more sophisticated instrumentation will increase as companies develop advanced engineering, industrial and electronic materials," said a Frost & Sullivan analyst, who conducted research for the report "Advances in Microscopy—A Global Technology Assessment,"².

Collectively, the various imaging modalities and accessories generated \$1.65 billion in 2004 and – with an average annual growth rate of 11% – revenues should reach \$2.77 billion in 2009, according to the Trimark report. Excluding accessories, the growth rate is 11.6% such that revenues should approach \$2.5 billion by 2009. The United States accounted for the largest share, representing one-third of the market. Japan made up 20% of the market, while other Asian countries represented 16%. The European Union accounted for a share of 18%.

Light microscopes represent the majority of the life sciences market, though its sales are growing at rates lower than other imaging devices, according to the Trimark report. In 2004, U.S. sales of 311,000 light microscopes totaled \$651 million. With a growth rate of 5.3%, sales should reach \$796 million for the sale of 395,000 light microscopes in 2008, when the growth rate is expected to slow to 4.8%. Manufacturer Nikon owns 32% of the market share, while Olympus owns 28% and Carl Zeiss owns 25%.

The sale of 1492 electron microscopes – both scanning and transmission types – accounted for revenues of \$308 million in 2004, according to the Trimark report. The growth rate of 8.5% should increase revenues to \$334 million for the sale of 1619 units in 2008. Lead manufacturer Hitachi owns 23% of the market share, while Jeol owns 20%. Other top manufacturers include Philips, Leica and ELA-Tenecor.

Providing images with quality superior to that of light microscopes, confocal microscopy has earned a widespread following during the last several years. In 2004, sales of 373 confocal instruments brought in \$74 million in revenues, according to the Trimark report. With a growth rate of 7.4%, revenues should reach \$98.5 million, for the sale of 461 instruments, by 2008. Bio-Rad and Leica are the lead manufacturers with 41% and 36% market share, respectively.

The use of confocal imaging equipment is further broadened by the high-throughput protocols made popular with the surfacing of proteomics, newer drug development strategies and increased involvement in clinical diagnostics. Harnessed into automated devices and paired with cooled charge-coupled devices, confocal imaging enables high-content screening, "the new watchword," according to Frost & Sullivan's microscopy report. The sale of 771 of such automated imaging systems brought in \$76.7 million in 2004, Trimark found. According to its report, the growth rate of 23% could be expected to yield \$154.9 million in revenues by 2008, when the growth rate should be 14%.

Market Overview (cont'd.)

Increasing appreciation of and reliance on the digitized medium is also driving sales as researchers strive for higher efficiency and accuracy. Unlike the relatively rudimentary tools of the past, "Computerization of microscopic procedures means that manufacturers can now produce lenses with less distortion, higher resolution and greater color rendition, allowing for greater precision in imaging quality," the Frost & Sullivan report concluded.

¹ Trimark Publications LLC, *Microscopy Markets*. January 2005.

² Frost & Sullivan, *Advances in Microscopy—A Global Technology Assessment*. March 2005.

Survey Introduction

The 2005 Cellular Imaging and Imaging Analysis Survey is designed to provide microscopy and imaging equipment vendors with information about the competitive landscape in the science marketplace. Data were gathered from questions regarding the cellular imaging systems and applications that customers are using in their laboratory research (and from whom they purchase the systems), the types of detection technologies researchers use, the number and type of fluorescent labels they use, what level of resolution is adequate for their research, the number of images generated and the amount of visual control preferred for imaging applications, the type and supplier of imaging software most commonly in use by researchers, and open questions asking for cellular imaging products, services, or software, currently unavailable commercially, which would facilitate their research. With this information, suppliers will be better able to target product development in directions of current research interest with the goal of increasing their market share in the cellular imaging arena. Additionally, vendors may choose to focus on specific imaging applications that have the potential for the greatest amount of revenue growth, again strengthening their position in the imaging market.

The 2005 Cellular Imaging and Imaging Analysis Survey consisted of 23 questions. Of these, 3 were open-ended and 7 of the closed-ended questions included "other" as an answer choice, permitting survey participants to provide a more appropriate answer to the specific question that was asked. Demographic information was gathered from 6 additional questions and from addresses submitted by survey respondents. The survey was administered on-line from September 19th-23rd, 2005, and the data tabulated and presented here.

Appendix I: Questionnaire

In what type of institution do you work?

- Private Research
- Government
- Biotech
- Pharmaceutical
- Clinical Diagnostic Testing
- Academic
- Other

Which title best applies?

- Professor/Instructor
- Process Engineer
- Business Development Director/Manager
- Research Director/VP of Research
- Department Head
- Technician/Research Assistant
- Account Manager
- Graduate Student
- Staff Scientist
- Principal Investigator
- President/CEO/Owner/VP
- Lab Director/Chief Scientist
- Postdoctoral Fellow
- Procurement Manager
- Consultant
- Other

What is your principle area of research or work? (check all that apply)

- Bioinformatics
- Microbiology/Virology
- Immunology
- Genomics/Genetics
- Cell Biology
- Diagnostics/Pathology
- Drug Discovery
- Administration
- Biochemistry
- Marketing/Sales
- Pharmacology/Toxicology
- Molecular Biology
- Bioengineering
- Neuroscience
- Proteomics
- Purchasing
- None of the Above
- Other (please specify)

Which best describes your purchasing authority?

- Authorize
- Recommend
- Evaluate
- No Purchase Role

How would you characterize your cellular imaging use?

- Frequent Use
- Regular Use
- Occasional Use
- I do not use cellular imaging – *exited from survey*

For what are you currently using cellular imaging?

- Target Validation
- Lead Characterization
- Drug Screening
- Basic Research
- Forensics
- Clinical Diagnostics
- Other (please specify)

Which of the following are you currently using to image cells? (check all that apply)

- Fluorescent Microscope
- Confocal Microscope
- Light Microscope
- High Content Screening System
- Other (please specify)

What brand of equipment chosen in question #3 do you use? (The question will loop through the items selected in question #3. A separate question will appear for each piece of equipment.)

- Nikon
- Leica
- Olympus
- Molecular Devices
- Zeiss
- GE Healthcare
(formerly Amersham Biosciences)
- BD Biosciences (formerly Atto Biosciences)
- Cellomics
- Applied Precision
- Definiens
- Motic
- Other (please specify)

Which of the following cell-based assays do you currently use?

- Diagnostic Assays
- Cell-based Absorption Assays
- Cell Motility/Morphology Assays
- Cell Signaling Assays
- Cell Proliferation/Viability Assays
- Protease Assays
- Reporter Gene Assays
- Hormone Assays
- Phosphatase Assays
- Kinase Assays
- Membrane Potential Assays
- RNAi Assays
- Phosphodiesterase
- Toxicology Assays
- Ion Channel Assays
- Apoptosis Assays
- Protein Translocation Assays
- Fusion Tag Assay Kits
- None of the Above
- Other (please specify)

If you prefer confocal over CCD/Wide Field based imaging what are the reason or specific assays that you feel require confocal? (Open-ended)

For live cell assays that you would run on an automated sub-cellular imager, please rank the following in terms of how likely you are to require them as a means of evaporation control.

(1 = Most likely to be required, 5 = Least likely to be required)

- Layer of mineral oil (to combat evaporation where there is no humidity control)
- Plate cover (to combat evaporation where there is no humidity control)
- Keeping beakers of water in the instrument (to maintain humidity)
- Passive humidity method (to reduce evaporation and maintain humidity)
- Active evaporation control (sensor reactive method to maintain humidity)

What types of cells do you use?

- | | |
|--|-----------------------------------|
| - Epithelial-like cells (HeLa, CaCo2) | - Melanoma |
| - Fibroblast-like cells (HEK 293, Cos-7) | - Monocytes/macrophages |
| - Endothelial-like cells (HUVEC, BAEC) | - Myotubes/myoblasts/muscle cells |
| - Hepatocyte-like cells (HEPA-1, HepG-2) | - Keratinocytes |
| - Neuroblastoma (CLBPEC, SHEP) | - Primary cells |
| - Leukemia cells/Lymphoblasts (Jurkat, K562) | - Other (please specify) |

Which of the following detection technologies do you use?

- | | |
|---|-----------------------------------|
| - Labeled antibodies | - FRET |
| - Cell stains (e.g, hematoxylin, eosin, etc.) | - pH sensitive dyes |
| - Radioactive labels | - Quantum Dots (i.e. nanospheres) |
| - Fluorescent dyes | - None of the Above |
| - Quencher dyes | |

How many fluorescent probes do you typically use in one sample?

- 0
- 1
- 2
- 3
- 4
- 5 or more

Which of the following fluorescent labels do you currently use in fluorescent microscopy applications?

- | | |
|---------------|--------------------------|
| - CyDyes | - Oregon Green |
| - Alexa Dyes | - Pacific Blue |
| - Fluorescein | - Marina Blue |
| - Texas Red | - Rhodamine |
| - BODIPY | - Hoechst Dye |
| - FITC | - Other (please specify) |

Which level of visual control do you prefer for your application?

- None: fully automated analysis required.
- Need to see intermediate results while tuning the assay.
- Extensive: need to visually inspect intermediate analysis steps and spot-check classification results.

Do you use digital camera to document cell images?

- Yes
- No

What brand(s) of digital camera(s) do you use?

- | | | |
|--------------|--------------------|--------------------------|
| - Carl Zeiss | - QImaging | - Redlake |
| - Olympus | - Sony Electronics | - Lumenera |
| - Optronics | - Nikon | - Cooke Corporation |
| - PixelLink | - Panasonic | - Other (please specify) |
| - Polarioid | | |

What level of resolution do you find adequate in a cellular imaging documentation system or camera?

- 1 – 2 Megapixel
- 2 – 4 Megapixel
- 4 – 6 Megapixel
- 6 – 8 Megapixel
- 8 – 10 Megapixel
- 10 – 12 Megapixel
- 12+

How many images per day do you generate?

- 1 – 50
- 50 – 100
- 101 – 500
- 501-1000
- 1001 – 3000
- 3001 – 6000
- 6000+

Where do you typically store your images?

- Lab notebook
- Compact discs
- Individual hard drive
- Server

Do you use image analysis software?

- Yes
- No

To the best of your knowledge, who is the manufacturer and what is the name of image analysis software you use for cellular imaging? (Open-ended)

Ideally, what would you like to see in an image analysis software package that would serve your purpose? (Open-ended)

Which of the following products do you plan to purchase in the next 12 months?

- Imaging System Software
- Imaging Analysis Software
- Inverted Microscope Imaging System
- Confocal Imaging System
- HCS Data Management Software
- Multi-use CCD Imaging System
- High Content Screening System
- None of the Above

What are the three main criteria you would choose to make a purchasing decision of an imaging system? (please choose three)

- Recommendation
- Past Use
- Brand Recognition
- Advertisements
- Personal Demonstration
- Hardware Performance
- Breadth of Applications
- Software performance
- After Sale Support
- Budget
- Technical support
- Availability of Reagents
- Other (please specify)

What cellular imaging and image analysis product or service, currently not available commercially, would help facilitate your microscopy research? (Open-ended)