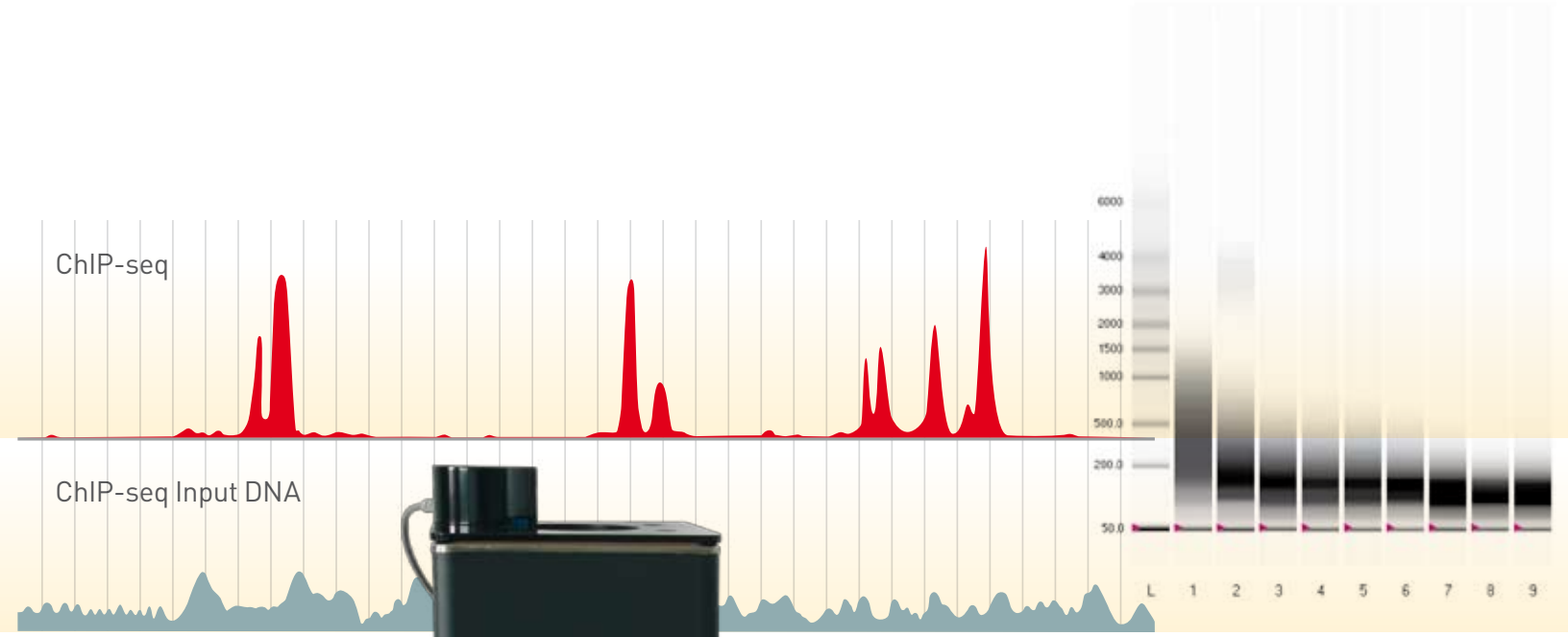
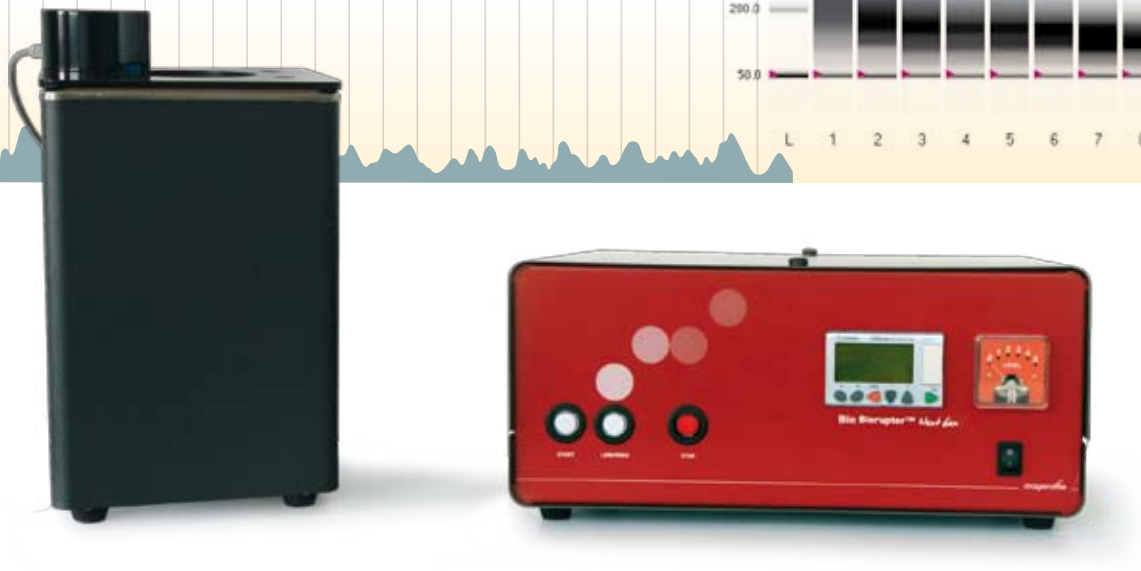
diagenode

Innovating Epigenetic Solutions

Bioruptor® Sonicator

The industry standard for DNA shearing: Essential for DNA methylation, chromatin immunoprecipitation and high-throughput sequencing studies.





Bioruptor® Sonicator offers unsurpassed reproducibility & quality

Bioruptor® Sonicator ensures success for a variety of applications

Diagenode's Bioruptor® Sonicator uses state-of-the-art ultrasound technology to disrupt, disperse, or shear a variety of sample types for biological, chemical, pharmaceutical, and industrial applications. The Bioruptor® Sonicator is widely used in biological settings and has proven success for efficient, reproducible sonication required for applications such as DNA/chromatin shearing, cell lysis, cell poration, and protein extraction. Researchers have confirmed the Bioruptor® Sonicator as an optimal shearing system, surpassing industry standards with high yields of superior quality material, as exemplified by over 200 publications.

Features and benefits of the Bioruptor® Sonicator

The Bioruptor® Sonicator provides:

- **Unsurpassed quality, consistency, and efficiency**
  - Closed tube format prevents cross-contamination and aerosol formation
  - Variable power range efficiently and evenly disrupts samples
  - Unique cooling system retains integrity of biological complexes
  - Gentle ultrasound method preserves samples
  - Sample rotation of tubes in water bath ensures shearing and lysis consistency

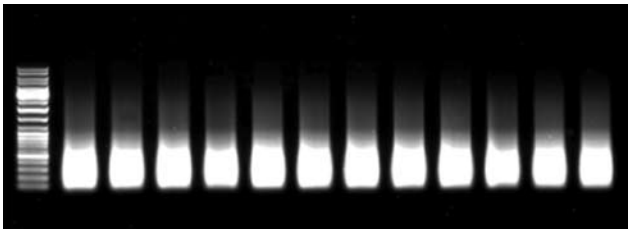


Figure 1. The Bioruptor® achieves highly consistent fragmentation that ChIP requires in the shearing of chromatin DNA complexes.

- **Compatibility with existing lab workflows:** Uses standard microfuge and conical tubes
- **Ease of use:** Easy set-up, operation, control parameters, and maintenance ensures success
- **High-throughput capability:** Allows parallel processing of up to 48 samples
- **Scaling ability:** Interchangeable sample holders allow for microliter to milliliter quantities.
- **Application flexibility:** Efficient ultrasound technology enables high yields and reproducibility across biological, chemical, pharmaceutical, and industrial applications

Customer Feedback

"Although many options exist, we routinely generate high quality libraries [using sonication]. The Bioruptor® is lower in cost, while achieving higher energy transfer efficiency and more reproducible performance than standard probe sonicators. In addition, multiple samples can be processed simultaneously in a uniform manner."

Hodges et al. (Nature Protocols 4, - 960 – 974, 2009) describing preparation of DNA for high-throughput sequencing

Bioruptor® Sonicator shows high reproducibility for high-throughput sequencing library generation

Application highlight: Bioruptor® in biology

Chromatin Immunoprecipitation (ChIP) and Methylated DNA Immunoprecipitation (MeDIP) Assays:

- Consistency and narrow size range of sheared DNA (between 300-600 bp) that ChIP and MeDIP demand
- Sample quality with intact chromatin complexes through the shearing process
- Multiplexing with standard lab tubes
- Compatibility with downstream ChIP and MeDIP applications (e.g. ChIP-qPCR, ChIP-chip, ChIP-seq, MeDIP-seq)
- Widespread success by several prominent chromatin research groups

For a complete list of customer publications and established protocols visit the Diagenode website at www.diagenode.com

High-throughput "next generation" sequencing

The Bioruptor® Sonicator is the DNA shearing device of choice for sequencing applications, providing optimal yields, lengths, and consistency as shown in Figure 2. Different fragment size ranges are frequently required for downstream applications (e.g. bridge amplification) for sequencing. The Bioruptor® can be easily programmed to modify duration of sonication for optimal fragmentation and produces:

- Desired narrow size distribution (e.g. 150–250 bp) crucial for sequencing accuracy
- High yields of double-stranded DNA needed for effective sequencing results
- Compatibility with downstream workflow steps (e.g. optimal linker additions, glycerol avoidance)

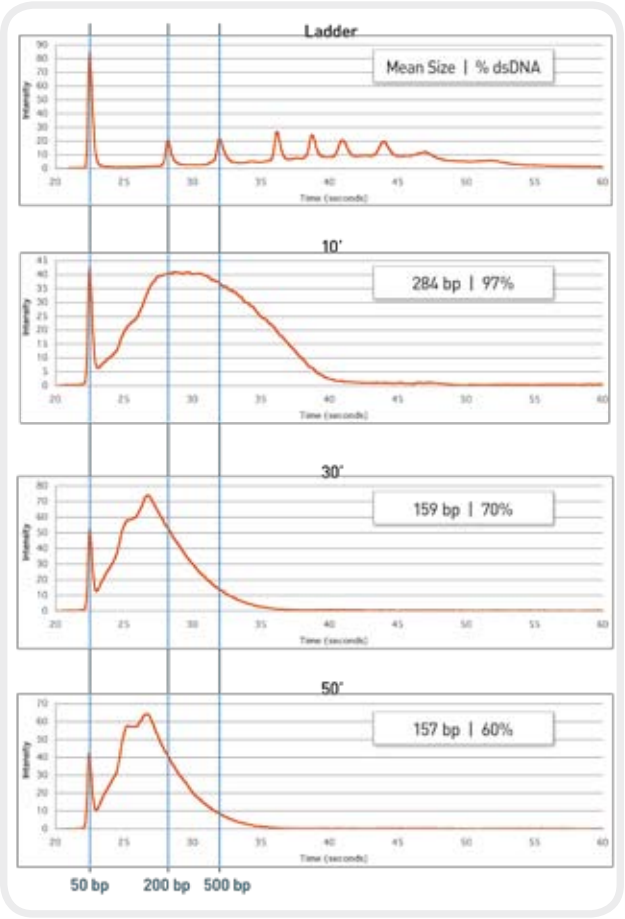


Figure 2. Bioruptor® Sonicator achieves optimal size distributions and yields for high-throughput sequencing. By manipulating the duration of sonication, the Bioruptor® ensures that most DNA fragments lie within the narrow size range required for applications such as ChIP or sequencing. Here, an automated shearing time of 50 minutes is best to maintain yield and complexity for optimal library construction for next generation sequencing, as shown by the narrow size distribution (compared to the DNA ladder) and high dsDNA yields (measured by Qubit; data not shown here).

Customer Feedback

"Our experiments indicate that the Bioruptor® provides a wider and more uniform size range compared to nebulization. Additionally, more of the DNA mass is sheared to the relevant size-range. This increases the flexibility of size selection and decreases the amount of DNA lost in the process. The Bioruptor® is also capable of processing up to 6 samples in parallel, while nebulization is performed one at a time, with a single sample per device."

Shendure lab, University of Washington

The Bioruptor® Sonicator is the instrument of choice

Choosing the right Sonicator

The Bioruptor® Sonicator is the industry's most versatile sonicator. Tip/probe sonicators typically deliver focused energy, and the resulting heat generation may degrade the sample, leading to undesirable effects for ChIP (chromatin disaggregation) and high-throughput sequencing (low yields of double-stranded DNA). Other sonication instruments are not recommended for biological uses given the issues with low-throughput, high set-up costs, and variable sample quality.

	Bioruptor® Sonicator	Tip/Probe Sonicators
Wide range of applications	X	X
Enables random shearing vs. enzymatic methods	X	X
Multiplexing with standard lab tubes	X	
Scalable with holders for sample volume flexibility	X	
High-throughput processing ability	X	
Gentle ultrasound irradiation does not degrade sample	X	
Reproducible: Closed system prevents sample contamination	X	
High yields of dsDNA for high-throughput sequencing	X	

Application versatility

The Bioruptor® can be used in industrial and pharmaceutical applications.

See www.diagenode.com for a complete list of applications.

Biological applications include:

- Shearing
- Cell disruption
- Lipid dispersion
- Protein solubilization
- Preparation of receptor specimens

Selected chemical applications include:

- Chemical bond breaking
- Free radical formation
- Reaction catalysis
- Emulsification
- Degassing
- Polymerization

Cavitation explained

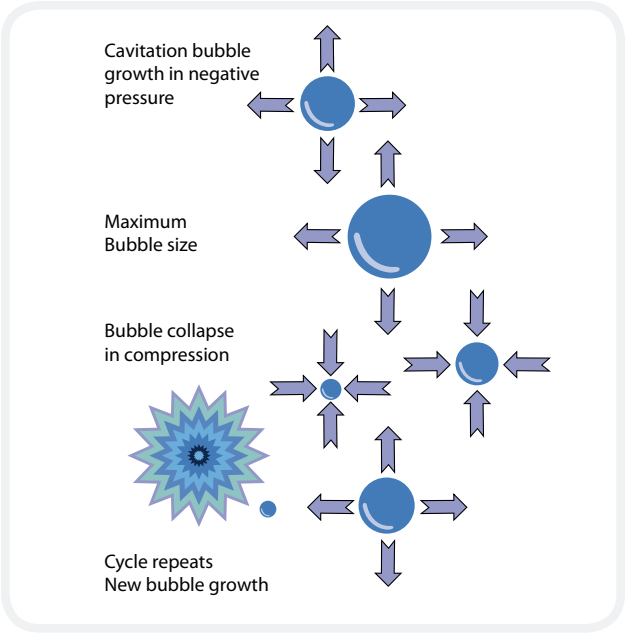
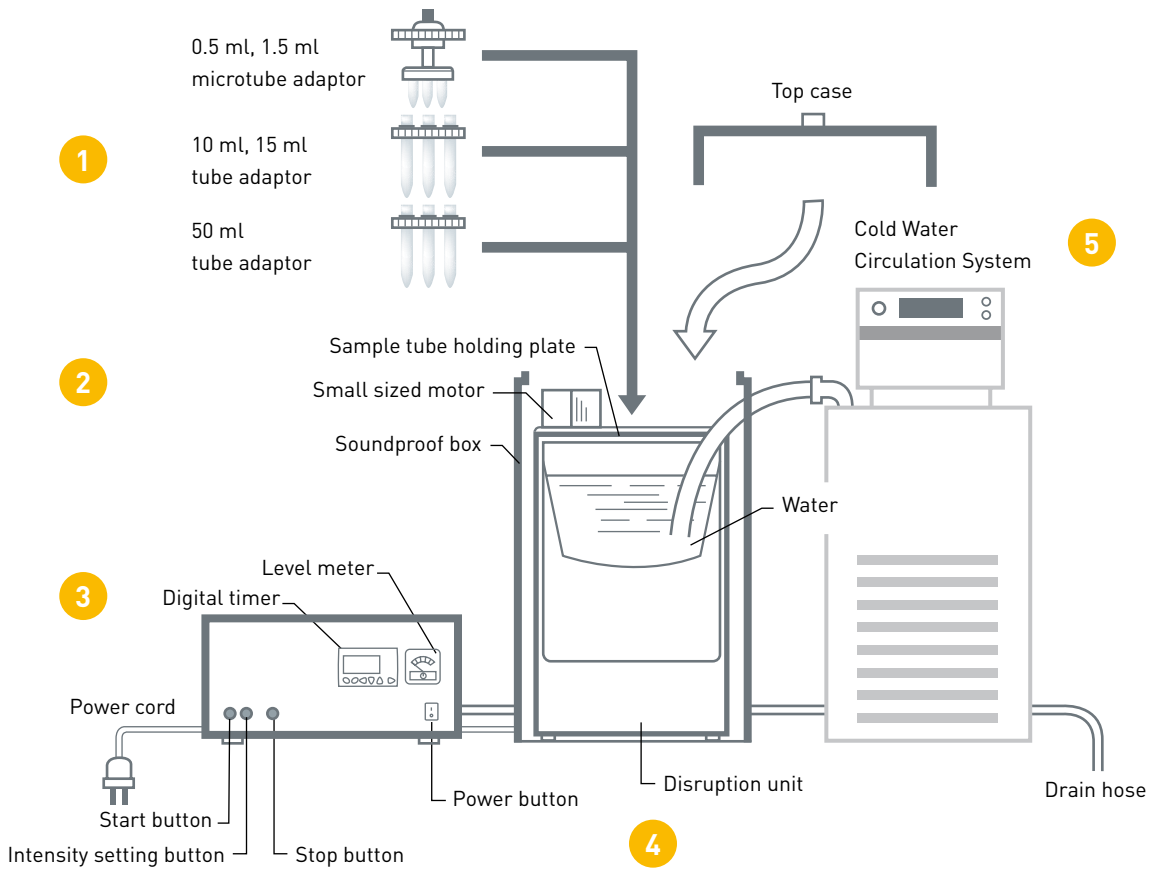


Figure 3. The Bioruptor® Sonicator uses ultrasound to create focused mechanical stress to lyse cells or shear DNA or chromatin. The ultrasound waves pass through the sample, expanding and contracting the liquid. During expansion, negative pressures pull the molecules away from one another and a form a cavity or bubble. The bubble continues to absorb energy until it can no longer sustain itself and then implodes, producing intense focused shearing forces, which disperses or breaks biomolecules.

How the Diagenode Bioruptor® works

Some of the key design features of the Bioruptor® are the laboratory friendly format, ability to use many sample tube types in a water bath-based rotor, and flexible power controls. The walls of the waterbath reflect the ultrasound waves in a random but reproducible pattern. The samples in the adaptor are rotated through the ultrasound field to expose each sample to the same level and intensity of energy. This novel technology enables a wide range of applications for superior yields and quality.



1

Flexible sample Format

Fits into current workflow with standard tubes

Scales with flexible sample volume

2

Rotation

Prevents contamination with closed tubes

Continuous rotation through water bath guarantees equal distribution of energy

3

Flexible control

Easy to program

Power range effectively disrupts samples

4

Ultrasound

Gentle ultrasound method preserves sample

5

Cooling system

Cooling system maintains integrity of sensitive samples

A flexible selection of Bioruptor® models suits your needs

Attributes of our most popular Bioruptor® Sonicator models

STANDARD

NEXT-GEN

TWIN

XL

	Bioruptor® UCD-200	Bioruptor® UCD-300	Bioruptor® UCD-400	Bioruptor® XL-2006
Description summary	Standard, basic model with reliable performance across applications	Upgrade of UCD-200 with improved displays and controls for greater timing accuracy and temperature control	Provides high-throughput ability and processes up to 24 samples simultaneously	Provides high-throughput ability and processes up to 48 samples simultaneously Ideal for cell lysis Not validated for all kind of DNA and chromatin samples
Throughput & multiplexing	Tube size / # of tubes processed 0.5ml 12 1.5ml 6 10ml 6 15ml 6 50ml 3	Tube size / # of tubes processed 0.5ml 12 1.5ml 6 10ml 6 15ml 6 50ml 3	Tube size / # of tubes processed 0.5ml 24 1.5ml 12 10ml 12 15ml 12 50ml 6	Tube size / # of tubes processed 0.5ml 48 1.5ml 24 10ml 24 15ml 24 50ml 12
Timer & controls	Analog timer	Digital timer & controls	Digital timer & controls	Digital timer & controls
Sound-proofing	Plastic soundproof box	Metal soundproof box	Metal soundproof box	Metal soundproof box
Monitoring ability & control systems		Control systems to automatically manage and monitor instrument components	Control systems to automatically manage and monitor instrument components	

Customer Feedback

"My general conclusion is that the Bioruptor® UCD-300 is much more appealing than the UCD-200 model. This is primarily due to the increased comfort of usability and the homogeneity of the sonication time programming. We find the UCD-300 model takes the robust platform of the UCD-200 and provides perfect sonication efficiency."

Jérémy Dufourt, Laboratory of Dr Chantal Vaury, University of Clermont-Ferrand, France

Selected Bioruptor® references

The Bioruptor® has been cited in over 200 publications, and is trusted by leading researchers in epigenetics, ChIP, methylation studies, and for library preparation in next generation sequencing.

ChIP

Cuthbert G. L., Daujat S., Snowden A. W., Erdjument-Bromage H., Hagiwara T., Yamada, M., Schneider R., Gregory P.D., Tempst P., Bannister A.J., Kouzarides T. Histone deimination antagonizes arginine methylation. ***Cell, 118 (5), p.545-553*** **(2004).**

Acevedo, LG, Iniguez, AL, Holster, HL, Zhang, X., Green, R., Farnham, PJ. Genome-scale ChIP-chip analysis using 10,000 human cells. ***Biotechniques. 43: 791-797*** **(2007).**

Lopez-Serra L., Ballestar E., Fraga M.F, Alaminos M., Setien F. and Esteller M. A Profile of Methyl-CpG Binding Domain Protein Occupancy of Hypermethylated Promoter CpG Islands of Tumor Suppressor Genes in Human Cancer. ***Cancer Res 2006; 66: (17)*** **(2006).**

Sandmann T., Jakobsen J.S., Furlong, Eileen E.M. ChIP-on-chip protocol for genome-wide analysis of transcription factor binding in Drosophila melanogaster embryos. ***Nature protocols, 1 (6), p.2839-2855*** **(2006).**

Navarro P., Page D.R., Avner P. and Rougeulle C. (2006). Tsix-mediated epigenetic switch of a CTCF-flanked region of the Xist promoter determines the Xist transcription program. ***Genes & Development 20:2787-2792*** **(2006).**

Unité de Génétique Moléculaire Murine, Institut Pasteur 75724, Paris Cedex 15, France.

Durant M. and Pugh B.F. NuA4-Directed Chromatin Transactions throughout the Saccharomyces cerevisiae. ***Molecular and Cellular Biology, p. 5327–5335*** **(2007).**

Mikkelsen T.S., Ku M., Jaffe D.B., Issac B., Lieberman E., Giannoukos G., Alvarez P., Brockman W., Kim T.K., Koche R.P., Lee W., Mendenhall E., O'Donovan A., Presser A., Russ C., Xie X., Meissner A., Wernig M., Jaenisch R., Nusbaum C., Lander E.S., Bernstein B.E. Genome-wide maps of chromatin state in pluripotent and lineage-committed cells. ***Nature; 448:553-560*** **(2007).**

Rosenthal A.Z., Kim Y. and Gralla Y.D. Poising of Escherichia coli RNA Polymerase and Its Release from the Đ38 C-Terminal Tail for osmY Transcription. ***J. Mol. Biol. 376, 938–949*** **(2008).**

MeDIP

Yasui D.H., Peddada S., Bieda M.C., Vallero R.O., Hogart A., Nagarajan R.P., Thatcher K.N., Farnham P.J. and LaSalle J.M. Integrated epigenomic analyses of neuronal MeCP2 reveal a role for long-range interaction with active genes. ***19416–19421 PNAS December 4, 2007 vol. 104 no. 49.***

Library preparation for next generation sequencing

Lister R., O'Malley R.C., Tonti-Filippini J., Gregory B.D., Berry C.C., A. Harvey Millar C.A. and Ecker J.R. Highly Integrated Single-Base Resolution Maps of the Epigenome in Arabidopsis. ***Cell 133, p523-536*** **(2008).**

Gregory B.D., O'Malley R.C.,Lister R., Urich M.A., Tonti-Filippini J., Chen H., Millar A.H. and Ecker J.R. A Link between RNA Metabolism and Silencing Affecting Arabidopsis Development. ***Developmental Cell 14, 854–866*** **(2008).**

Cokus S.J., Feng S., Zhang X., Chen Z., Merriman B., Haudenschild C.D., Pradhan S., Nelson S.F., Pellegrini M and Jacobsen S.E. Shotgun bisulphite sequencing of the Arabidopsis genome reveals DNA methylation patterning. ***Nature 452, 215-219*** **(2008).**

Application Note: Gregory B.D. Next generation sequencing library preparation following preparation of proper-sized DNA molecules using the Bioruptor® (complete application note http://www.diagenode.com/pages/support_appl_notes.html).

Protein extraction

Bunk V., Kaehne T., Degtyarev D., Shcherbakova T. and Reiser G. Novel isoenzyme of 2-oxoglutarate dehydrogenase is identified in brain, but not in heart. ***FEBS Journal 275, 4990-5006*** **(2008).**

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Dissolution of aggregates

Diehl F., Li M., He Y., Kinzler K. W., Vogelstein B., Dressman D. BEAMing: single-molecule PCR on microparticles in water-in-oil emulsions. ***Nature Methods, 3 (7), p.551-559*** **(2006).**

Cell Dispersion

Sun B., Tanji Y., Unno H. Influences of iron and humic acid on the growth of the cyanobacterium Anabaena circinalis. ***Biochemical Engineering Journal 24, 195–201*** **(2005).**

Bacterial Lysis

Md. Kabir S., Yamashita D., Koyama S., Oshima T., Kurokawa K., Maeda M., Tsunedomi R., Murat M., Wada C., Mori H. and Yamada M. Cell lysis directed by DE in early stationary phase and effect of induction of the rpoE gene on global gene expression in Escherichia coli. ***Microbiology, 151, 2721–2735*** **(2005).**

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Ordering information

Description	Reference
Bioruptor® Models	
Bioruptor® Standard	UCD-200 TM (1.5 mL) UCD-200 TO (1.5 mL & 15 mL)
Bioruptor® Standard (new)	UCD-300 TM (1.5 mL) UCD-300 TO (1.5 mL & 15 mL)
Bioruptor® Twin	UCD-400 TM (1.5 mL) UCD-400 TO (1.5 mL & 15 mL)
Bioruptor® XL	XL TM (1.5 mL) XL TO (1.5 mL & 15 mL)
Sample Tube Adaptor Kits	
0.5 mL (12) Microfuge tube accessory kit	UCD-pack 0.5
1.5 mL (6) Microfuge tube accessory kit	UCD-pack 1.5
10 mL (6) tube accessory kit	UCD-pack 10
15 mL (6) tube accessory kit	UCD-pack 15
50 mL (3) tube accessory kit	UCD-pack 50
Cooling System	
Water Cooler	BioAcc-cool
Connectors Kit for Water Cooler	CONN-7D1
Peristaltic pump (including Connectors kit)	TWI-pump
Valve Kits	
Valve kit for UCD-300	VB-100-0001
Valve kit for UCD-400	VB-101-0001

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