

# diagenode

A Hologic Company

BIORUPTOR®  
MEGARUPTOR®  
POWER FOR EVERY APPLICATION



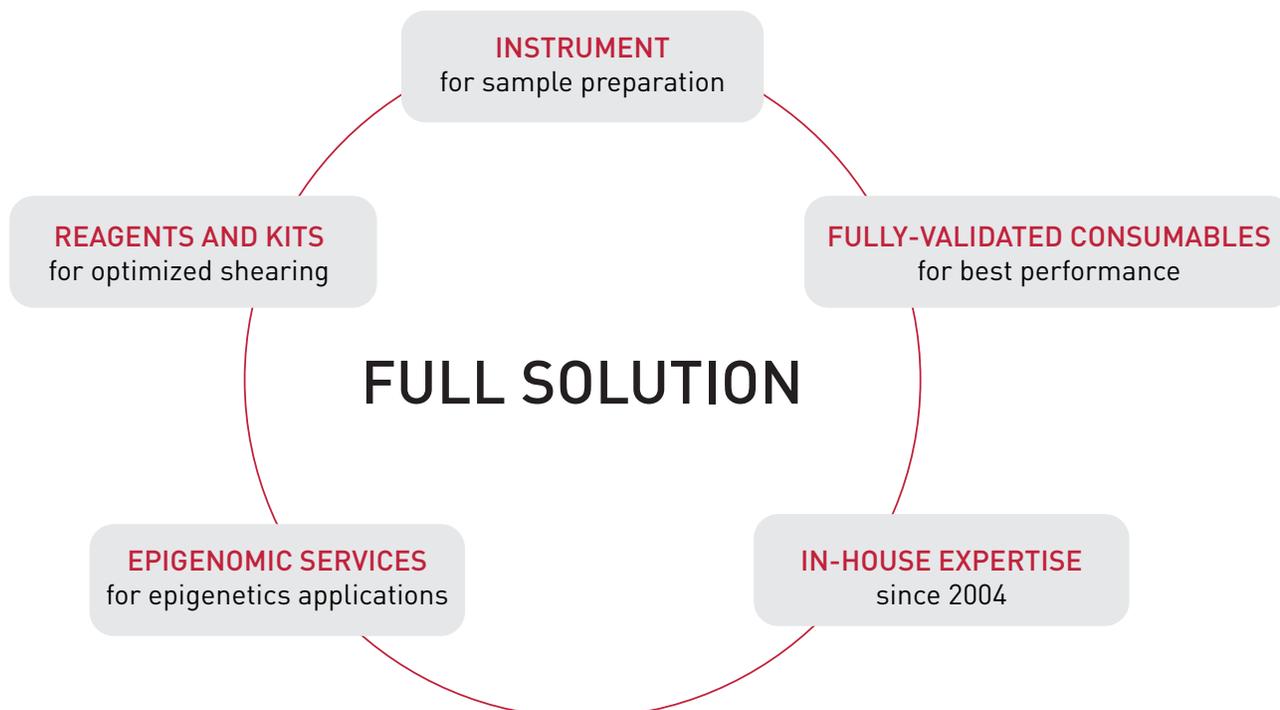
## STATE-OF-THE ART SHEARING DEVICE FOR:

- DNA and RNA shearing
- Chromatin shearing
- FFPE nucleic acid extraction
- Tissue and cell disruption
- Protein, DNA, RNA extraction
- Protein aggregation

Bring epigenetics  
workflows to new frontiers

# Bioruptor®

Diagenode focuses on state-of-the-art preparation of high quality biological and chemical samples by developing the industry's most advanced water bath sonicators and hydrodynamic devices. Our instruments are ideal for a number of applications in various fields of studies including environmental research, toxicology, genomics and epigenomics, cancer research, stem cells and development, neuroscience, clinical applications, agriculture, and many more.



# The Bioruptor is validated by researchers in over 6,000 citations for diverse applications



CHROMATIN



DNA



RNA

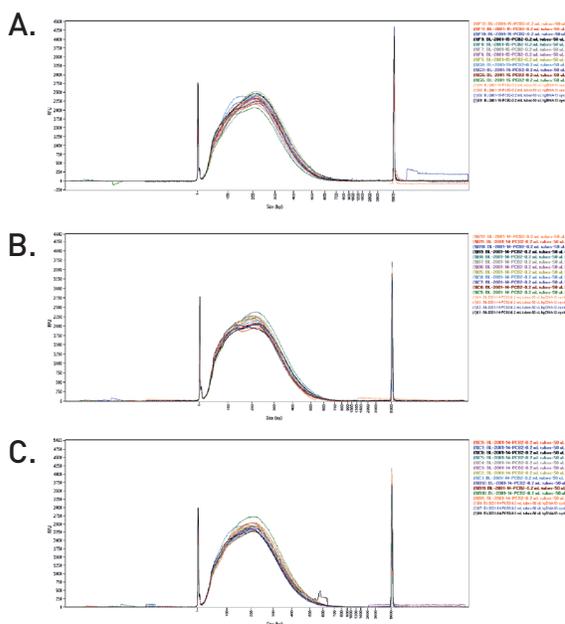


PROTEIN

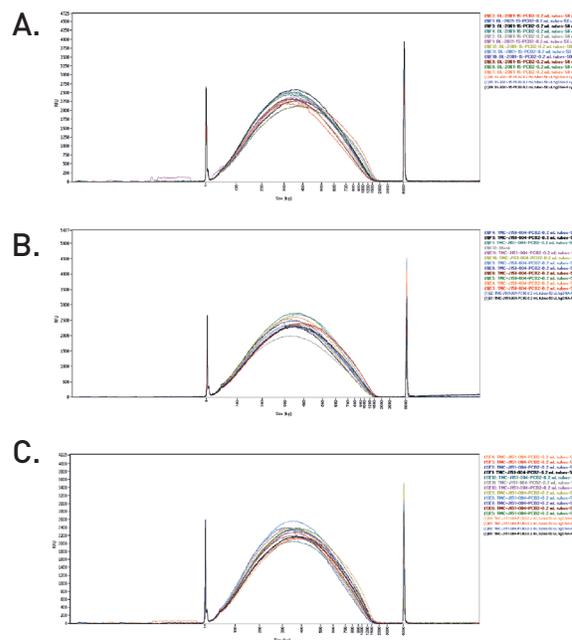


CHEMICALS

## Reproducibility is our priority



**Figure 1.** DNA samples of 50  $\mu$ l were sheared in 0.2 ml microtubes with three different Bioruptor Pico (13 cycles and 30/30 seconds ON/OFF) and analyzed on the Fragment Analyzer (Agilent). The overall average size is **197 bp $\pm$ 3.7%**.



**Figure 2.** DNA samples of 50  $\mu$ l were sheared in 0.2 ml microtubes with three different Bioruptor Pico (4 cycles and 30/30 seconds ON/OFF) and analyzed on the Fragment Analyzer (Agilent). The overall average size is **349 bp $\pm$ 5%**.

## They trust us!

“My group is mostly focused on epigenetic reprogramming, and I have been using Diagenode products for the last 5 years. My experience with antibodies, CHIP kits and the Bioruptor is nothing but positive. Diagenode products are unique for reproducibility, and this has always been a great plus for the success of my experiments.”

**Dr. Raffaele Teperino - Environmental Epigenetic Group - Institute of Experimental Genetics, Helmholtz Zentrum Muenchen GmbH, Germany.**



“High throughput sequencing has dramatically reduced sequencing costs, and the development of dual indexing strategies makes it possible to combine 384 samples in a single sequencing run. By developing library preparation methods to enrich for retroviral integration sites and retroviral transcripts we have been able to produce large numbers of low cost libraries to track the evolution of infection and to characterise patterns of expression from our virus of interest. The Bioruptor Pico has been an essential part of our protocols and provides straightforward and consistent shearing of our samples.”

**Dr Keith Durkin, Unit of Animal Genomics, GIGA-R  
Université de Liège , 4000 Liège, Belgium.**

“We are using the Bioruptor Pico on a daily basis along with the iST kits for our protein sample processing workflows. The ultrasonication-based lysis greatly improves cell and tissue disruption, as well as shearing of DNA, generating samples with significantly increased peptide and protein identifications. The Bioruptor Pico in our lab has successfully processed several thousands of samples such as cells, mammalian and plant tissues, bacteria or yeast. We are highly satisfied with the handling and reproducibility of the instrument and recommend it to improve sample preparation for protein analysis.”

**Dr. Fabian Hosp, Head of Applications, PreOmics, Martinsried, Germany.**



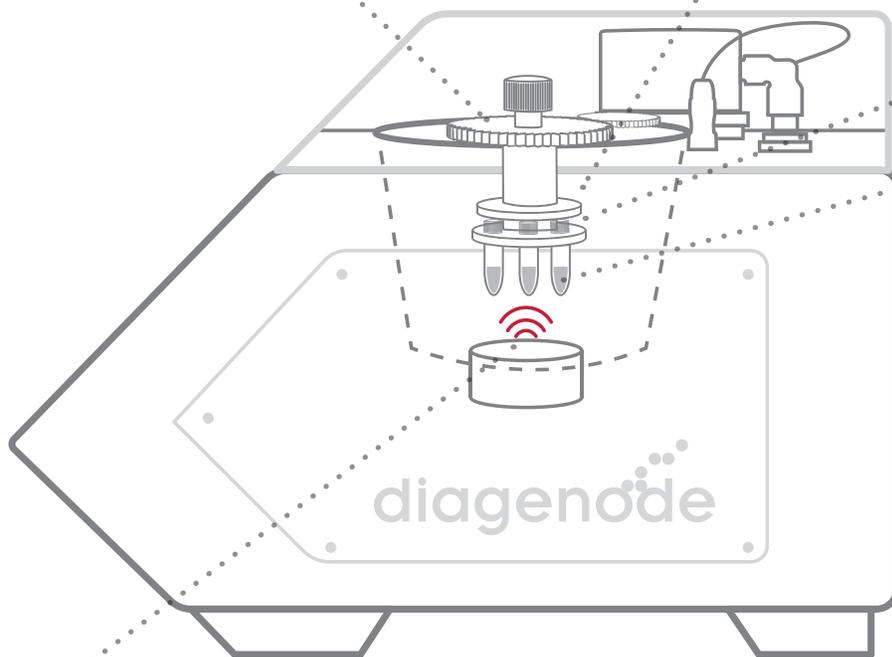
# Bioruptor benefits

## ROTATION

The samples in the tube holder are rotated through the ultrasound field to expose each sample to the same intensity of energy and ensure shearing consistency.

## NON-CONTACT

The Bioruptor utilizes a sonication bath-based rotor. The walls of the sonication bath reflect the ultrasound waves in a random but reproducible pattern. The Bioruptor sonication bath is equally exposed to ultrasound energy allowing for the dissipation of heat and providing uniform absorption of energy.



## ADAPTIVE CAVITATION TECHNOLOGY (ACT)

Uses a highly-controlled ultrasonic energy with ACT to accurately achieve random and unbiased shearing for different fragment lengths from 150 bp to 1 kb. The gentle ultrasound preserves the integrity of biological samples and ensures high sample recovery.

## PATENTED

US9464314B2 -- Fragmenting DNA sequences longer than 10,000 bp using ultrasonication  
BE1024657B1 -- Support for sample tubes for the sonication of a biological material

**FAST PARALLEL-PROCESSING**

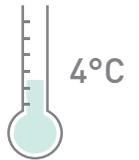
The design of the tube holders allows you to run up to 16 samples simultaneously in a run of a maximum of 30 minutes.

**CLOSED ENVIRONMENT**

The closed tube format prevents the sample from cross-contamination and aerosol formation.

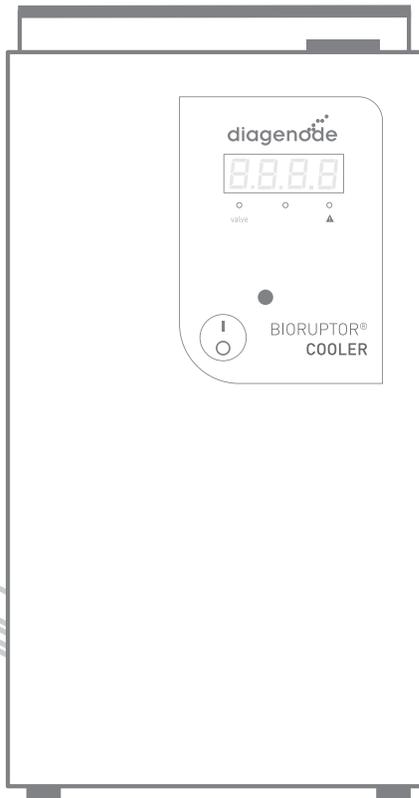
**ISOTHERMAL TECHNOLOGY**

A unique cooling system provides isothermal processing to preserve biological samples.



**FULLY VALIDATED TUBES**

Diagenode provides specific tubes that ensure maximum energy delivery to samples with minimal attenuation of ultrasound intensity.



**LOW RUNNING COST**  
**< 1€/\$/DNA sample**

# A complete portfolio



## Bioruptor® Pico

### THROUGHPUT

Simultaneous sonication of **6 - 16 samples**

### SAMPLE VOLUME

Ultra-low volumes of **20 µl** to larger samples of up to **2 ml**

### TEMPERATURE-CONTROLLED

Cooling system with integrated valve\* to guarantee the automatic temperature control of the bath during the full shearing process.

*\* Not shown in the picture*



DNA



CHROMATIN



RNA



PROTEIN

### Designed for any researcher

Easy and Advanced modes give both beginners and experienced users just the right level of control.

### Safety is our concern

The closed system assures safe use of the Bioruptor.

## Relax, we assure your research projects!

The Bioruptor Pico is **guaranteed for 5 years\***, a long-term promise of quality.

On top of that, maintenance contracts are available for custom services. You decide the service you need for your Bioruptor.

*\* Check detailed conditions of the warranty and contracts with Diagenode.*



## Bioruptor® Plus

### THROUGHPUT

Processing of **3 - 12 samples**

### SAMPLE VOLUME

Sample size **100 µl – 20 ml**

### TEMPERATURE-CONTROLLED

Cooling system with an external valve\* to guarantee the automatic temperature control of the bath during the full shearing process.

\* Not shown in the picture



CHROMATIN



PROTEIN



CHEMICALS

### Flexibility in larger sample volumes

The Bioruptor Plus is an excellent device for shearing chromatin, cell and tissue disruption and offers a large range of large sample volumes.

### Use with ease

Design simplicity with minimum control of different parameters.



## Diagenode One

### THROUGHPUT

Sonication of **1 sample** per shearing run

### SAMPLE VOLUME

Low volumes of **20 µl** and **50 µl** in microfluidic chips

### TEMPERATURE-CONTROLLED

Fully integrated cooling system



DNA



CHROMATIN

### Designed to fit any bench

The smallest (200 (W) x 285 (D) x 165 (H) mm) and lightest (5 kg) Diagenode shearing device.

### Introduction to microfluidics

The Diagenode One device uses microfluidic chips allowing shearing of lower sample volumes.

# Find your solution



| PRODUCT                | DIAGENODE ONE  | BIORUPTOR® PLUS   |
|------------------------|--|---|
| DESCRIPTION            | The compact bench top device for optimal sample preparation    | Best suited for cell and tissue sample preparation  |
| KEY APPLICATIONS       | Chromatin shearing 200 bp - 1 kb<br>DNA shearing 200 bp - 1 kb | Chromatin shearing 200 bp - 1 kb<br>DNA/RNA/Protein extraction<br>Mass spectrometry<br>Chemical applications  |
| THROUGHPUT             | 1 sample   | 12 samples (for 0.5 ml tube holder)<br>6 samples (for 1.5 ml tube holder)<br>6 samples (for 15 ml tube holder)<br>3 samples (for 50 ml tube holder) |
| RECOMMENDED VOLUMES    | 20 and 50 µl   | 100 µl (0.5 ml Bioruptor tubes)<br>100 - 300 µl (1.5 ml Bioruptor tubes)<br>300 µl - 2 ml (15 ml Bioruptor tubes)<br>2 - 20 ml (50 ml tubes)        |
| TEMPERATURE CONTROLLED | ✓  | ✓   |



### BIORUPTOR® PICO

Best suited for ChIP-seq and NGS  
sample preparation

Chromatin shearing 200 bp - 1 kb  
DNA shearing 150 bp - 1 kb  
RNA shearing 200 bp - 1 kb  
FFPE nucleic acid extraction  
Cell lysis and tissue disruption  
Mass spectrometry  
Protein aggregation

16 samples (for 0.2 ml tube holder)  
12 samples (for 0.65 ml tube holder)  
6 samples (for 1.5 ml tube holder)  
6 samples (for 15 ml tube holder)

20 - 100  $\mu$ l (0.2 ml Bioruptor tubes)  
100  $\mu$ l (0.65 ml Bioruptor tubes)  
100 - 300  $\mu$ l (1.5 ml Bioruptor tubes)  
300  $\mu$ l - 2 ml (15 ml Bioruptor tubes)



## Application versatility

### FFPE nucleic acid extraction

Deparaffinization of FFPE samples is typically performed using a non-polar solvent, such as xylene, or a mineral oil-based method which can be time consuming and messy. Using Diagenode's Bioruptor is a superior method for **removing the paraffin and rehydrating FFPE tissues in just one solvent-free step** followed by a mild crosslink reversal to preserve DNA and RNA integrity.

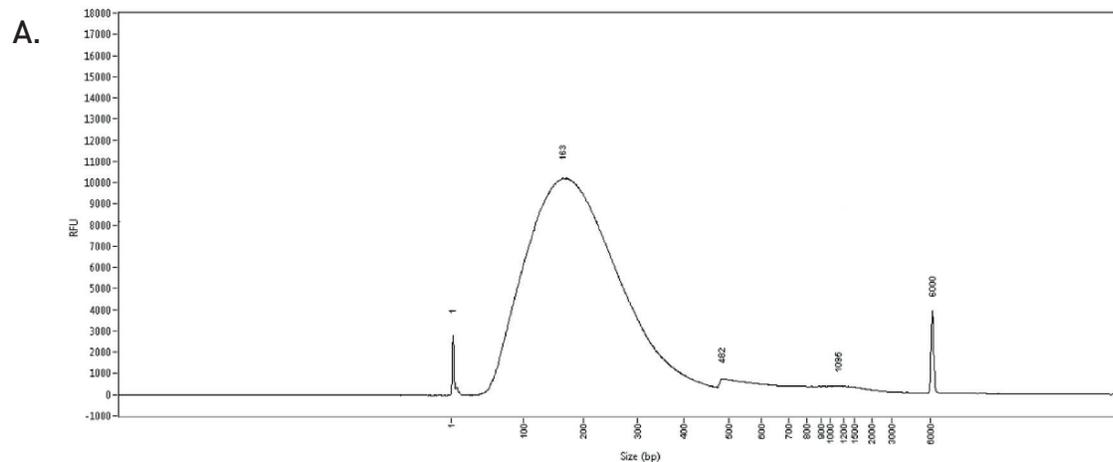


#### Efficient deparaffinization of FFPE sections by sonication with Bioruptor

10  $\mu\text{m}$  sections were sonicated for 3 cycles (30 sec ON/OFF at RT) with the Bioruptor Pico. The paraffin has been emulsified and completely dissociated from the tissue section.

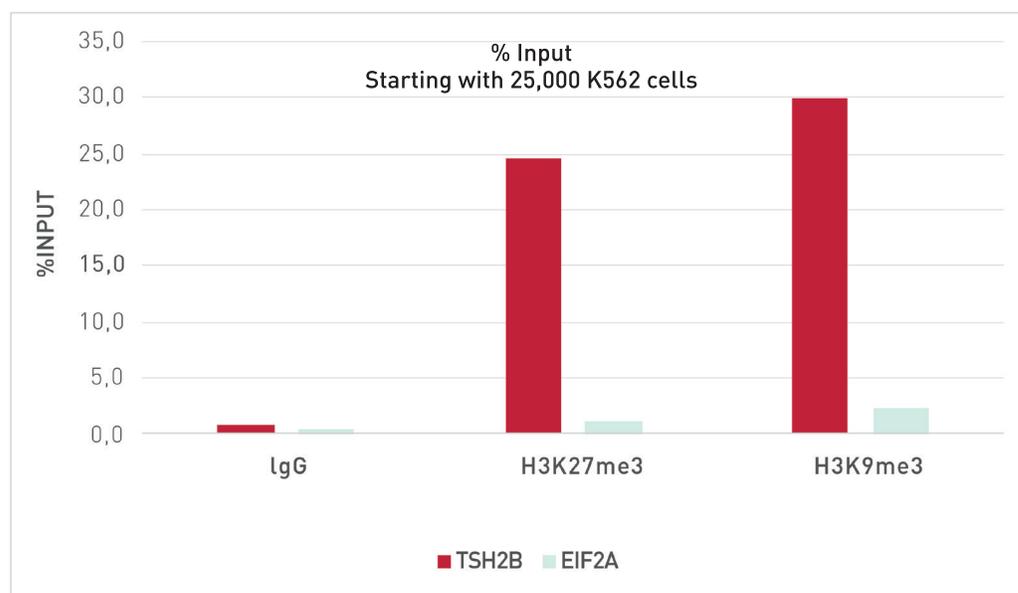
### Chromatin shearing

The most important steps for a successful ChIP include both cell fixation and lysis, and chromatin shearing. Diagenode's Bioruptor uses state-of-the-art ultrasound technology to give the highest chromatin quality for high IP efficiency and sensitivity for ChIP experiments **with gentle yet highly effective shearing forces**. Additionally, the Bioruptor provides a **precisely controlled temperature environment** that preserves chromatin from heat degradation such that **protein-DNA complexes are well-preserved** for sensitive, unbiased, and accurate ChIP.



**Successful chromatin shearing from K562 cells using the Bioruptor Pico and the True MicroChIP Kit (Diagenode).** Chromatin from K562 was sheared using the Bioruptor Pico for 5 cycles (30" ON/30" OFF). Chromatin was decrosslinked and purified accordingly to the protocol for chromatin shearing analysis and fragment size was assessed using the Fragment Analyzer (Agilent).

B.

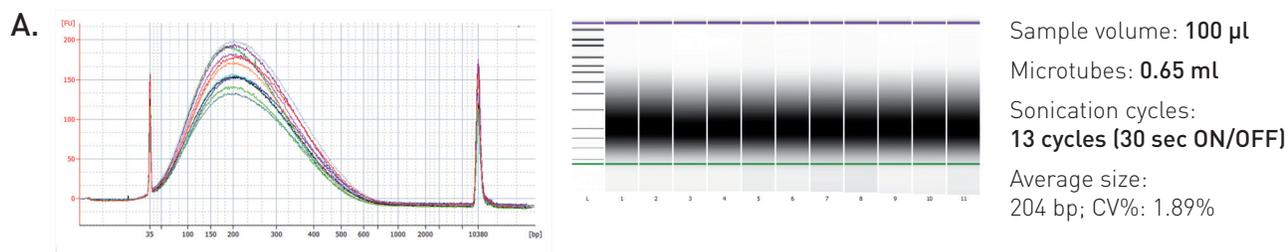


**Chromatin immunoprecipitation analysis from K562 cells using control H3K27me3 and H3K9me3 antibodies.** ChIP was performed on 25,000 cells using control H3K27me3 and H3K9me3 and negative IgG control antibodies following the True MicroChip protocol (Diagenode). Quantitative PCR was performed with the positive control TSH2B promoter and the negative control EIF2A primer sets. The recovery, expressed as a percent of input, is shown.



## DNA shearing

Next Generation Sequencing (NGS) has revolutionized genomics and biology. One of the most critical aspects of optimal library preparation is the quality of the DNA to be sequenced. The DNA must first be **effectively and consistently sheared into the appropriate fragment size** (depending on the sequencing platform) to enable sensitive and reliable NGS results. The Bioruptor provides superior sample yields, fragment size, and consistency, which are essential for Next Generation Sequencing workflows.



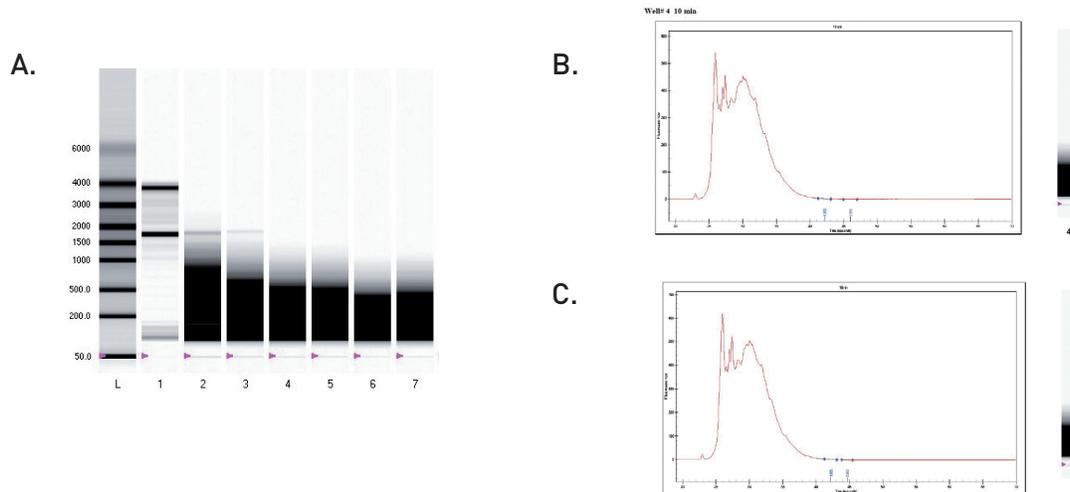
### High reproducibility with Bioruptor Pico

Image shows peak electropherogram view (left), virtual gel view (center) and shearing conditions (right).



## RNA shearing

RNA sequencing is a highly accurate and sensitive method to obtain unprecedented information about the transcriptome. The RNA must be fragmented to an appropriate size for sequencing prior to reverse transcription. The Bioruptor provides **unbiased RNA shearing** for best cDNA synthesis and ensures high quality Next Generation Sequencing.

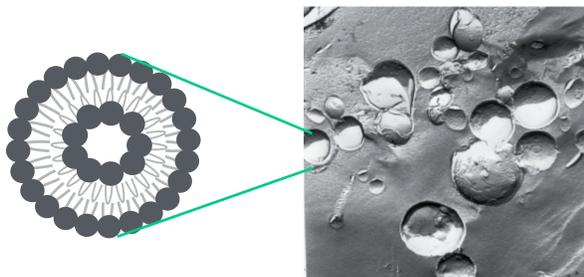


### Programmable RNA size distribution and excellent reproducibility with Bioruptor Pico

The various panels show different RNA size distributions of sheared total RNA produced by varying the duration of sonication on the Bioruptor. Panel A shows duplicate profiles produced after 5 (lanes 2-3), 10 (lanes 4-5) and 15 minutes (lanes 6-7) (30 sec on/off) of sonication. Lane 1 shows the unfragmented total RNA (starting material). Panel B and C compare the RNA size distributions of sheared total RNA from 2 different experiments. All samples were analysed on Biorad Experion using Eukaryote Total RNA HighSens chip.

## Liposome preparation

Sonication is one of the most common methods employed for liposome preparation. The Bioruptor provides high **throughput** and **reproducibility** and eliminates the need for direct contact to **prevent sample contamination**. The precise temperature control **preserves the lipids** from damage through overheating or oxidation.



### Size reduction of multilamellar vesicle

Peter Stone and Yvonne Perrie from Aston University and University of Strathclyde process MLV generated using the thin film lipid hydration method with the Bioruptor. The 100  $\mu$ l samples are sonicated 15 minutes at 45°C in the Bioruptor Plus with high power for rapid small scale production of bilayer-loaded liposomes.



## Protein extraction

Various biochemical and analytical techniques require the extraction of protein from tissues or mammalian, yeast and bacterial cells. Obtaining **high quality and yields of proteins** is important for further downstream protein characterization such as in **PAGE, western blotting, mass spectrometry or protein purification**. The efficient disruption and homogenization of tissues and cultured cells obtained in just one step using the Bioruptor delivers high quality protein.

**The PreOmics iST sample preparation of proteins combined with the Bioruptor Pico enhances mass spectrometric analyses.**

PreOmics shows that sample preparation of Baker's yeast (*Saccharomyces cerevisiae*) with the iST Kit combined with the Bioruptor Pico outperforms the workflow with the heat treatment alone.

Thus, the sonication-based cell lysis aids in proteome-wide discovery by greatly enhancing the number of peptide and protein identifications.



| Boiling at 95°C (min) | Bioruptor Pico sonication (cycle time)* | #proteins | #peptides | Alkylation [%] | protein ID change relative to condition 1 | peptide ID change relative to condition 1 |
|-----------------------|---|-----------|-----------|----------------|---|---|
| 0                     | 0                                       | 1721      | 4933      | 1.0            | -   | -   |
| 10                    | 0                                       | 1671      | 4652      | 1.4            | -3%                                       | -6%                                       |
| 0                     | 10                                      | 1856      | 7007      | 7.4            | +8%                                       | +42%                                      |
| 10                    | 1                                       | 1918      | 7446      | 7.5            | +11%                                      | +51%                                      |
| 10                    | 2                                       | 1936      | 7584      | 7.6            | +13%                                      | +54%                                      |
| 10                    | 5                                       | 1984      | 7867      | 8.2            | +15%                                      | +59%                                      |
| 10                    | 10                                      | 2093      | 8476      | 7.9            | +22%                                      | +72%                                      |

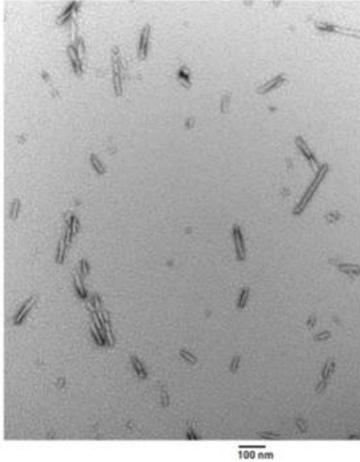
\*Each cycle corresponds to 30 sec ON and 30 sec OFF.



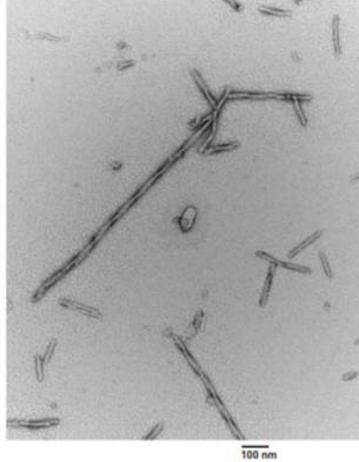
## Protein seeding and aggregation

The formation of amyloid-like aggregates (amyloid fibrils) disturbs normal proteome function and contributes to toxicity in **neurodegenerative disease**. To study the properties of amyloid formation and cellular propagation, sonication is typically used for both **preparing seeds** by breaking apart amyloid fibers for new aggregate growth and **stimulating the formation of amyloid aggregates**. The Bioruptor provides a number of benefits in **standardizing** and creating representative seeding material with its closed system and controlled sonication and temperature.

**Bioruptor Plus: 10 cycles**



**Human unsonicated**



Example EM images showing PFFs before and after sonication in the Bioruptor Plus after 10 cycles. See “Standardizing seeding experiments using the Bioruptor® for the understanding of the neuronal alpha-synuclein pathology” from Kelvin Luk, Ph.D., from the University of Pennsylvania to read more and see similar results using the Bioruptor Pico.





Your partner  
in long-read sequencing

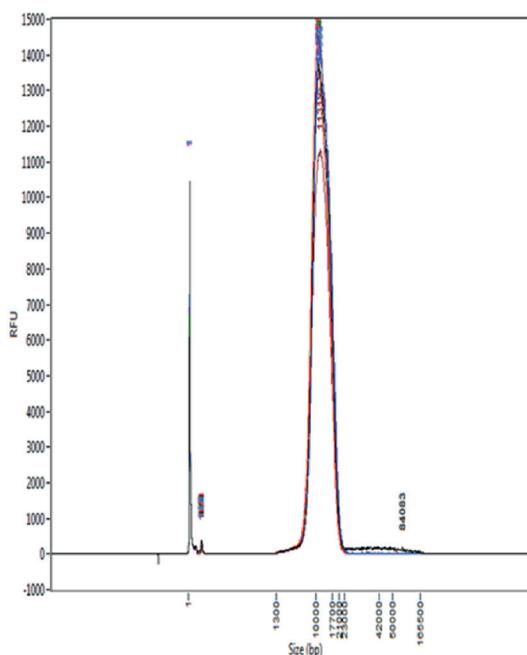
# Megaruptor®

Sequencing technologies have revolutionized genomics and biology research. Long read sequencing enables researchers to access a more comprehensive view of genomes with higher accuracy. However, one of the most critical aspects of optimal library preparation is the quality of the DNA to be sequenced. The DNA must first be effectively and consistently sheared into the appropriate fragment size. The Megaruptor gives state-of-art shearing performance providing optimal long-read sequencing using PacBio® and Oxford Nanopore™ technologies.

## PRINCIPLE

The Megaruptor is an automated system that controls the liquid flow at the level of a precisely manufactured consumable: the **hydropore**. It uses the principle of mechanical shearing to fragment DNA. As DNA in solution is pushed through a hydropore shearing device, it passes through an array of uniform pores. The resulting turbulent flow stretches and breaks the DNA strands. The length of the resulting fragments is dependent mainly on the fluid flow rate. Passage of the DNA molecules through the hydropore ensures a minimum and uniform fragment length.

## PERFORMANCE



### Excellent reproducibility achieved with the Megaruptor 3

The Megaruptor 3 provides excellent shearing results for HiFi and microbial multiplexing libraries. Test shears of *E.coli* K12 are shown. The amount of gDNA input was 0.5 µg in a volume of 100 µl. Fragments lengths generated to 10 kb. Femtopulse analysis shows all 8 channels sheared within a variance of only 9%. Data generated by Pacific Biosciences.\*

*\*PacBio® and Pacific Biosciences are registered trademarks of Pacific Biosciences.*

Recommended by



*Don't shortcut  
your shearing!*



## They trust us!

“As a **PacBio** Certified Service Provider it is critical that sample processing in my laboratory is precise and reproducible. For genome sequencing projects, the fragmentation of genomic DNA to precise and reproducible sizes is essential in order to optimize conditions for library preparation, sequencing, and downstream assembly. For this my laboratory relies on the Megaruptor system. The Megaruptor is the optimal system for long DNA fragment generation and tight fragment length distribution.”

**Brewster Kingham, Delaware Biotechnology Institute, University of Delaware.**

“(...) We have noticed that the data yield of **Nanopore** sequencing can be notably increased by shearing the high molecular weight genomic DNA with an average size distribution of ~30kb and obtaining a read length N50 of 30 kb. In this context, the Megaruptor 3 was critical to achieve long, homogenous and reproducible DNA preparation.

(...) We have tested the Megaruptor 3 with genomic DNA from human blood, fibroblasts and difficult samples such as bacterial genomic DNA with high viscosity. (...).

Finally, handling of the Megaruptor 3 is quick, with a simple interface. Diagenode is fast in delivering consumables and these are ready-to-go (...).”

**Elena Buena Atienza and Dr. Nicolas Casadei, Institute of Medical Genetics and Applied. Genomics, University Clinics Tübingen.**

“Welcome to the newest member of our team: @Diagenode Mega3. One bottleneck eliminated for sequencing on **Nanopore** PromethION as we now are able to accurately fragment up to 8 samples simultaneously in 30 minutes.”

*Posted on TWITTER by* Tim De Pooter, Vlaams Instituut voor Biotechnologie - UAntwerp Center for Molecular Neurology, 2610 Antwerpen, Belgium.



## A complete portfolio



### Megaruptor<sup>®</sup> 2

#### THROUGHPUT

1 - 2 samples in series

#### SHEARING RANGE

Capable shearing range from 3 to 75 kb

#### DNA INPUT

Up to 20 µg

#### VOLUME

50 - 400 µl

#### Even punctual and small projects deserve automated sample prep.

Invests according to the throughput of your project and opt for a capacity that fits your needs. The Megaruptor 2 has an appropriate throughput for smaller or punctual projects.

#### Reliability

Developing the Megaruptor since 2012, we have accumulated years of experience.

### Megaruptor<sup>®</sup> 3

#### THROUGHPUT

1 - 8 samples in parallel

#### SHEARING RANGE

Flexible shearing range from 5 to 100 kb

#### DNA INPUT

Up to 75 µg

#### VOLUME

65 - 500 µl



#### Unmatched quality

Our in-house experts optimized fragment distribution to match your applications.

#### Limitless shearing

The Megaruptor 3 offers the greatest capacity in terms of throughput and quantity of sample. It is also capable of shearing DNA from 5 to 100 kb, the largest shearing range available.

#### Designed for users

A small footprint and a removable cassette assure ergonomic and efficient use.



Request a demo!



Diagenode offers the possibility for you to get a demo system in your lab.  
Contact us to discuss options: [www.diagenode.com/pages/form-demo](http://www.diagenode.com/pages/form-demo)

Shop online in our EpiStore at  
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