



# BALLISTIC PARTICLE MANUFACTURING (BPM)

# BPM History

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- BPM was invented by Bill Masters. BPM was patented in 1987, and in 1988, Masters founded Perceptions Systems Inc.
- In 1992 their name was changed to BPM Technology Inc.
- The company collapsed in 1997 but their patent still held.

## BPM History Cont.

- The first BPM machine was represented as a compact office modeler.
- BPM manufacturing's role in the rapid prototype environment was as one of the pioneers of ink jet based office friendly systems which several vendors supply to the market.

# BPM History

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Bill Masters first described BPM as a spit wad. "When you shoot a lot of wads," he said, "they begin to take shape, and if you can control the direction of the wads and the motion of the device that's shooting them, you can produce any desired shape."

# BPM Technology

- The BPM personal modeler came with all hardware and software enclosed in one compact unit.
- The BPM is controlled by a DOS based 486 powered PC which is housed within the unit.
- The BPM utilized ink jet or droplet based manufacturing techniques, where it builds the models by firing micro-droplets of molten wax material from a moving nozzle or jet onto a stationary platform, the platform then lowers and the process is repeated for each layer of the model.

## BPM Technology Cont.

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- The part is built as a hollow shell.
- The parts can be scaled, rotated, or translated to a desired orientation. This is performed on a 5 axis workstation
- BPM parts are not intended to be finished, however they may be painted.

# BPM Process

- BPM employs a technology called digital Microsynthesis.
- 1.) In the first step of the process, molten plastic is fed to a piezoelectric jetting mechanism, almost like those of inkjet printers.
- 2.) Next a multi-axis controlled NC (Numerical Control) system shoots tiny droplets of material onto the target, using the jetting mechanism.

## BPM Process Cont.

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- 3.) Last, small droplets freeze upon contact with the surface, forming the surface particle by particle.

## BPM Uses

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- BPM parts are mainly used for concept visualization. Due to the weakness of the material, the parts aren't well equipped for use as functional components.
- BPM parts are useful during the design process.

# BPM Advantages

- Requires minimal post-processing.
- Low toxicity.
- Minimal power consumption.
- Low cost of cost and materials.
- Ability to perform in microgravity and vacuum environments.
- BPM has no size constraints.
- The process allows use of virtually any thermoplastic. Because of this, there are no heath hazards involved.

## BPM Disadvantages

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- Parts produced lack strength and durability.

# The Future of BPM

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- Incremental Fabrication Technologies
  - Developed system similar to BPM's
  - System focuses on metal materials rather than plastic
  - There have been successful fabrications out of tin and aluminum
  - Major advantage of this product is the ability to produce large metal parts

# The Future of BPM

- Texas Instruments:
  - Printed Computer Tomography
  - Major advantage is PCT has a building speed of one layer per minute.
- US Navy:
  - Electrosetting also called programmable molding
  - Technology uses electric fields to shape objects.
  - System consists of a computer, electrode printer, and high voltage power supply.
  - Major advantage of Electro setting is the ability to electically predetermine the material properties.

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  - Electrosetting also called programmable molding
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  - Major advantage of Electro setting is the ability to electrically predetermine the material properties.
  - Using this technology, one can program density, compressibility, hardness, and adhesion.

# Acknowledgements

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Rapid Prototyping Technology

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<http://ime.ucla.edu>

<http://memdrexel.edu>

<http://eov.gvsu.edu>