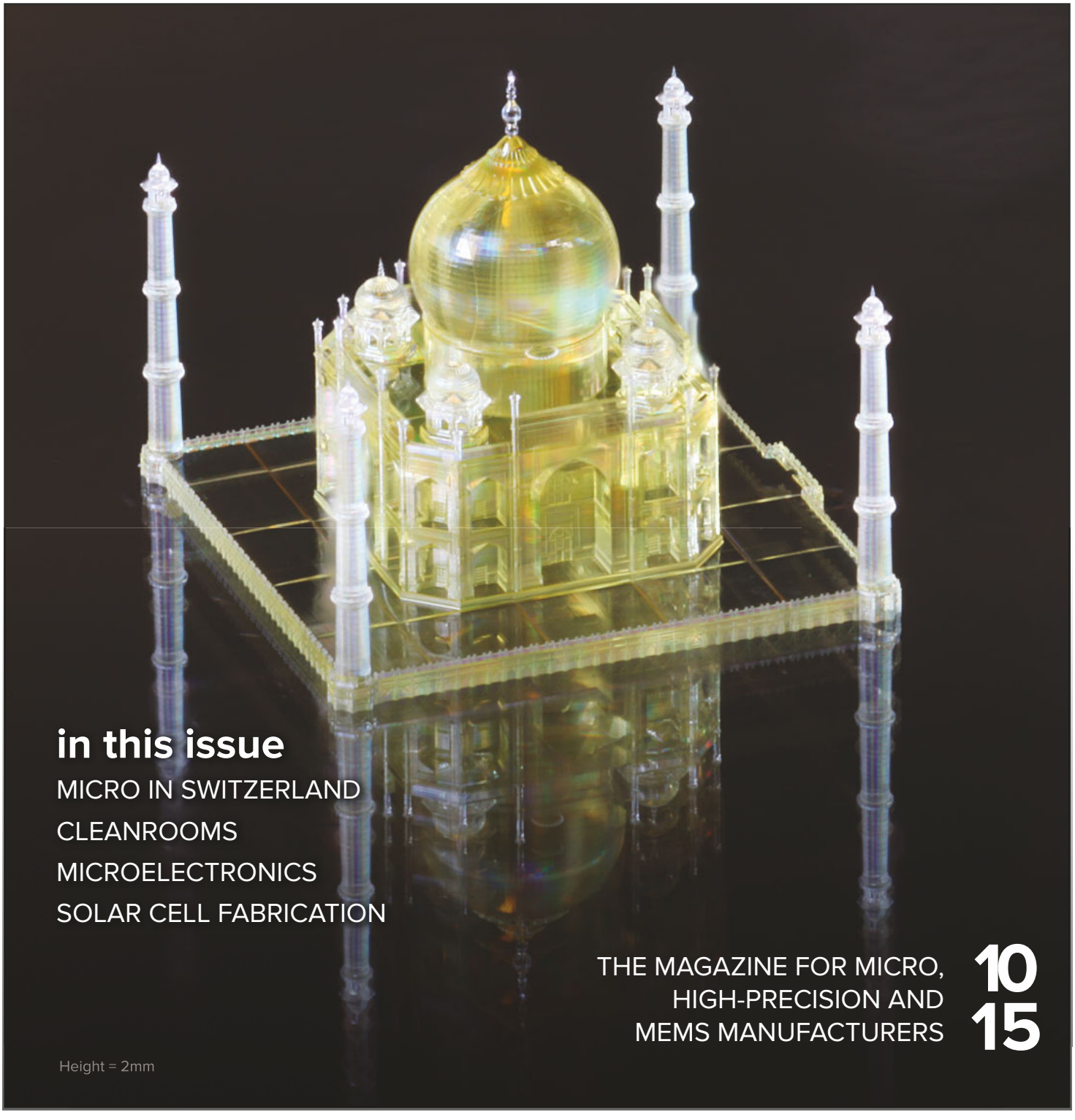
CMM international

COMMERCIAL MICRO MANUFACTURING



in this issue

MICRO IN SWITZERLAND
CLEANROOMS
MICROELECTRONICS
SOLAR CELL FABRICATION

THE MAGAZINE FOR MICRO, HIGH-PRECISION AND MEMS MANUFACTURERS

10
15

Height = 2mm

COMPLEMENTARY TECHNOLOGIES

REQUIRED FOR 21ST CENTURY ADDITIVE MANUFACTURING PRODUCT INSERTION

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A few months previous we had the pleasure of reading the "High-Precision Cleaning from Twente's Spin-off BuBclean" in the July/August issue of Commercial Micro Manufacturing magazine (focus on micro manufacturing in the Netherlands). This article spurred a closer look at how this complementary technology can assist in the development of new MEMS and nano process technologies. The authors partnered to develop an article centred on how this technology can assist in the additive manufacturing movement focusing on vastly improved ultrasonic techniques.

The movement toward 21st century personalised manufacturing comes with a requirement for complementary technologies required to enable the movement to improve. Personalised manufacturing or 3D printing has evolved into a diversified set of techniques today more correctly named Additive Manufacturing (AM). Less well known is that they require a fast, very efficient and often small-volume cleaning technology. A number of cleaning technologies have responded to the challenges posed by AM. Here we talk about one of those techniques and perhaps the leading one — ultrasonic cleaning.

New AM equipment manufacturers are coming forth seemingly every day, each excelling in one aspect of the technology, be it a new material extrusion or deposition capability, a decrease in work in process (WIP) time, less costly equipment, more energy efficient or improvements along some other dimension of manufacturability. AM today has moved from the initial deposition of powders or plastics to include extruded metals and even sintered products. The final AM-enabled production of a three dimensional product through this process allows for point-of-use product development for a specific application. The claim or promise of AM is that they are the basis for the next industrial revolution. It is moving manufacturing from mass production techniques that derive value through economic lot sizes and other cost reducing activities, to mass customisation that derives value through the development of a cost-effective specific manufactured product for an immediate use.

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Each piece of 3D printing equipment utilises a different set of materials and each piece of equipment has differing sets of nozzles and platforms that must be cleaned to useable standards. Further, most of the 3D parts produced by AM require 'post-treatment' which includes support-material removal surface finishing and corrosion resistance. Cleaning technologies need to improve to meet the challenges. The finer the 3D printed details the more extreme the cleaning problem in general. Ultrasonic cleaning is one of the techniques that hold promise for AM.

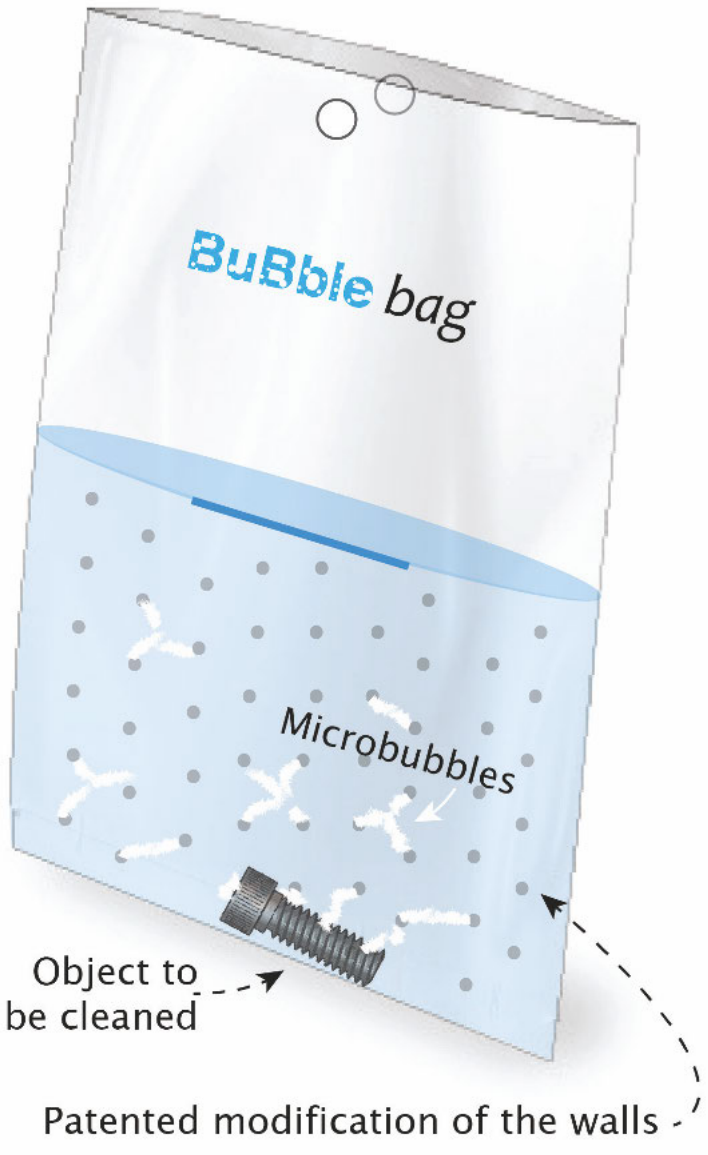
Current ultrasonic cleaning equipment and techniques utilise sound waves with frequencies of 20 kHz - 1 MHz. Ultrasonic cleaning was first developed for manufacturing applications soon after WWII and is a technology that people have grown to value. Manufactures and users of ultrasonic equipment have however learned to accept its traditional limitations. To stress this point, ultrasonic cleaning has been used successfully in some high-tech based mass production applications but were not found suitable in other applications that seemed promising. A good example of this can be found in the semiconductor industry. There were hopes that ultrasonic cleaning would be able to clean small-feature sized products, but silicon wafers with delicate structures were found to be a challenge. "Megasonic" frequency cleaning equipment was developed for these finer sized applications but the results have not been as good or reproducible as expected. Yet this is exactly the cleaning challenge that AM presents and that many that are interested in ultrasonic cleaning are seeking to address.

Ultrasonic cleaning techniques can now be developed to address problems that many thought were too sophisticated for ultrasonic cleaning solutions.

All traditional ultrasonic equipment relies on a random process of bubble creation by the ultrasound waves. It is this randomness that interferes with optimal, reliable and reproducible ultrasonic cleaning. One new company sought to improve fine ultrasonic cleaning by controlling where the generation of bubbles occurs. Interestingly this Dutch company BuBclean sells no equipment or any cleaning solution. They address the needs of fine sized AM cleaning as well as other contamination-related problems by improving the ultrasonic cleaning process itself. The control of where bubbles are generated makes it possible to achieve more efficient and localised cleaning with the use of fewer chemicals and less energy. This in turn reduces the risks of erosion damage to the object. This concept has been patented and productised, and brought to the market as 'BuBble bags.' These bags are excellently suitable for mass customisation, since large numbers of objects with different geometries can now easily be cleaned. BuBclean is providing the improvement in a complementary technology required by a robust AM movement.

Ultrasonic cleaning techniques can now be developed to address problems that many thought were too sophisticated for ultrasonic cleaning solutions. This improvement in ultrasonic cleaning allows the technique to be revisited by other industries besides AM that see a movement from mass manufacturing to mass customisation, such as user-specific contact lenses, personalised and ultrasonically prepared drugs, the semiconductor industry and low-number PCBs. Today, for example, BuBclean is addressing how to clean blind holes and materials with traditionally problematic properties. Modern miniature components and plastic parts made with additive manufacturing will benefit from new cleaning protocols and optimization of ultrasonic cleaning equipment.

BuBclean applies its patented technologies to cleaning applications. The focus is not only to improve the ultrasonic cleaning processes that are already in use, but also to expand ultrasonic processing to applications where ultrasound could not be used before. Opposite in figure 1 see a picture of a "BuBble Bag" and further see their video of how it can solve your problems at www.BuBclean.nl. Perhaps the promise of BuBclean is enabling AM's promise or the transition from mass production to mass customisation.



<< Figure 1: Picture of the BuBble bags in which modification of the internal walls leads to improved bubble formation for cleaning. >>