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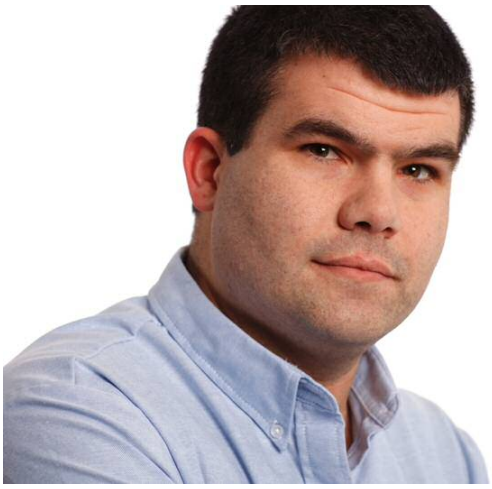
FABRISONIC

3D Metal Printing - Changing How the World Manufactures



Mark Norfolk
President & Chief Executive Officer

Fabrisonic LLC
www.fabrisonic.com

Contact:
Mark Norfolk
614-688-5000
mnorfolk@fabrisonic.com

Interview conducted by:
Lynn Fosse, Senior Editor
CEOCFO Magazine

"Ultrasonic additive manufacturing is allowing for the impossible to become possible."- Mark Norfolk

CEOCFO: ***Mr. Norfolk, what is Fabrisonic and sound 3D printing?***
Mr. Norfolk: Fabrisonic is a tech startup building metal 3D printers. We build machines that we sell to customers and use our own technology to 3D print metal parts. A great deal of our parts are for the aerospace industry. The reason we have a tagline of sound 3D printing is that our welding process for doing the 3D printing is based on ultrasound. We are using sound waves to weld layers of metal, one layer at a time, building a 3D shape.

CEOCFO: ***Has sound 3D printing been tried in the past?***
Mr. Norfolk: The idea of using ultrasound to weld metals has been around since the 1960s, in fact, pretty much any electronic part that you touch in your day to day life like cell phone, has ultrasonic welds in it. In the chip industry, they call that a wire bond, but it is an ultrasonic weld. We take that base called ultrasonic metal welding and scale it way up (increase power) in order to weld with 3D printing.

CEOCFO: ***How did you know it would work?***
Mr. Norfolk: Fabrisonic is kind of unique in that we are a spin out as a for-profit subsidiary of a non-profit called EWI (www.ewi.org) EWI, a non-profit research organization headquarter in Columbus, Ohio, has a whole department devoted to the use of ultrasound for different manufacturing technologies. There was quite a depth of knowledge already in the group when we started developing this technology. The technology, ultrasonic additive manufacturing or UAM, was developed in house at this nonprofit. After using the duct tape and bubblegum version of things, we proved that it worked, that the physics work, and then we started building true machines.

CEOCFO: ***3D printing is accepted but not everyone is using it yet. How do people make the leap to the ultrasonic?***
Mr. Norfolk: Ultrasonic additive manufacturing is a subset of what we call 3D printing. And 3D printing is a very hot industry right now with tremendous investment and technology group across a variety of materials in both plastic and metal. If you look at all the different metal 3D printing technologies, they are all different tools in the toolbox and these tools do not overlap that widely. The part you would make with ultrasonic additive manufacturing you would never be able to make with a powder bed fusion process. It is about leveraging the right tool for the right job.

CEOCFO: ***What might be a good fit for your technology?***
Mr. Norfolk: Our process is using sound and as it does that, we are doing the welding at very low temperature. The max temperature you see in our welding device is probably 200-250 degrees F. The very lowest setting on your oven at home is as hot as we get and we are truly welding metal to metal at that temperature. There are three distinct advantages with the low temperature process. The first is we can weld dissimilar metals. If you were to take aluminum, titanium and copper

and melt those then re-solidify them using an arc welding process or some sort of laser, the resulting structure would be a very brittle glass. With our process, we can mix aluminum, copper and titanium all in the same part, without losing the base metallurgic properties. We make many highly engineered components with multiple metals. The second area we do a lot of work on is embeddable electronics. With a max temperature of 200F, we can stop our 3D printing process at any point, drop in an electronic circuit, a sensor or some sort of monitoring device and continue to weld right over that so we have electronics very deep inside of a metal part where they can have a great use, for instance, health monitoring. We do a lot of embedded sensors in aerospace parts. Other, more high temperature processes would destroy a sensor embedded in this fashion. The last thing that we do really well is complex internal shapes. If you look at any 3D printing process, they can pretty much all make complex internal shapes. We fall into a world where we do a lot of heat exchangers. Because we can weld several different metals and make complex shapes, that lends itself to making highly engineered thermal management devices that cannot be manufactured with any other process

CEOCFO: ***Do potential customers understand?***
Mr. Norfolk: No, a big part of our marketing is education. The customers we have had the most success with are typically customers where we will actually send an engineer to their facility to work with their designers to really help them understand the possibilities with UAM. This is an entirely new way of thinking about engineering. We certainly have the opportunity to make great advancements, but it does take a new thought at design. We do a lot of work both educating customers and working with their design teams to get to that ultimate solution.

CEOCFO: ***How do you reach out and decide who might be receptive?***
Mr. Norfolk: A lot of our marketing and sales would be just direct outreach to make people aware the technology exists. A lot of what we do is work with periodicals like magazines to try to get an article placed that our customers might read and come talk to us about. We also go to a lot of industry trade shows like last week I went to two separate aerospace events presenting on our technology. We know that the aerospace field is really jumping in with both feet at 3D printing, so that is where we have spent a lot of our time. We do a lot of work with other industries as well. It is all about getting awareness for people.

CEOCFO: ***How does cost come into play?***
Mr. Norfolk: 3D printing in and of itself is very expensive. All 3D printers are very expensive and slow process. The way you get around that is you have to look at the total lifecycle and design of a part. In a traditional manufacturing technology where you bend, mill, weld any kind of a component, a single design may require fifteen separate parts, with that the customer is inventorying fifteen different skews. That means fifteen quality inspections from fifteen different parts, as well as the assembly later on down the line. What 3D printing often allows you to do is to put all of those different parts into one single print job. So, instead of carrying fifteen different parts, you are now carrying one part. Instead of inspecting fifteen different parts, you are inspecting one. Then because you can combine all of that functionality, you typically get a much higher performing part whether your performance is based on weight, thermal conductivity depends on the application, but often times, you get a much more efficient engineering design. Ultrasonic additive manufacturing is allowing for the impossible to become possible.

CEOCFO: ***Would you tell us more about your manufacturing facility and equipment? Do you have what you need?***
Mr. Norfolk: Our equipment starts off as a standard three axis mill, so we buy commercial, off the shelf, three axis CNC mills and we integrate in our welding technology. It is about integration of our IP into the preexisting motion system. We have a couple companies that we outsource that integration. We have multiple machines in-house for doing production for our customers. Right now, we are renting some space in Columbus Ohio. We have a new machine hopefully coming in June 2017, which we are pretty excited about. Right now, we have all the space we need, but being located in Columbus, there is lot of manufacturing here and finding facilities to grow is not that hard. There are many great manufacturing facilities around Columbus that have leasable space that meet our needs.

CEOCFO: ***What does that new piece of machinery do?***
Mr. Norfolk: It is another of our designed 3D printers. All of our machines are CNC mills with our weld head and are all used for 3D printing. We will print 2-10 layers of metal and we will CNC mill both the external and internal features. Then we will weld more layers of metal and then stop at some point and mill again. It is a hybrid system of milling (subtractive) and additive in the same system but it is all about 3D printing metal parts.

CEOCFO: ***What is the most exciting item that you have created?***
Mr. Norfolk: We have done a lot of cool parts. Unfortunately, a lot of them we are not allowed to talk about due to non-disclosures. A couple cool things are we have printed are satellite parts, so it is exciting to know that stuff that you are

working on is possibly orbiting us in space. We have also printing some parts with metal called Europium. It is a metal most people have never heard about, and in fact, the only real source for Europium is from the government. This is a part that we have built for a nuclear reactor down in Oakridge National Laboratories. That was pretty cool and we got to work with material that most metallurgists do not get to play with and you get to make a part that has high impact. Those are both two fun examples that we enjoyed working on.

COECFO: ***Why pay attention to Fabrisonic?***
Mr. Norfolk: The 3D printing area is going to change the way people do manufacturing around the world. Specifically talking about Fabrisonic, we certainly have a unique technology that allows you to do things you could not do any other way and that is embedded electronics and multiple metals in complex internal shapes. You put those together and you can make products that are just impossible with traditional manufacturing. Making what was once impossible is going to allow you to make higher performing parts, and over the lifetime of the part, is going to be significantly more cost competitive