

INTERVIEW WITH DR. BRADLEY D. CRAIG



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Interview with Dr. Bradley D. Craig, Ph.D., Scientist 3M Oral Care Solutions Division, one of the scientists behind the 3M™ Filtek™ Ultimate Universal Restorative.

Dr. Bradley Craig works as Division Scientist in the 3M Oral Care Solutions Division in St. Paul, Minnesota, USA. During his 19+ years in 3M Dr. Craig has conducted scientific research and development work on several oral care products. For most of his career he has been one of the scientists behind 3M's composite materials.

In the 3M. Science. Applied to Life™ brand positioning, we want to give insight into the people driving 3M's product innovations. The people applying the science to develop products that make life better.

What is your educational background and how you became a scientist?

I am half-chemical engineer and half materials scientist. I received my bachelors degree in chemical engineering from the University of Nebraska. During that time I was working at a number of different internships with several companies and actually realized that what I really enjoyed was the materials aspect of science. So I switched into materials science and moved to the University of Minnesota where I finally got my PhD.

How did you come to work in 3M?

It was the time when I was coming out of graduate school and working on a project that happened to be a good fit for a program that 3M was then conducting in their dental division. So I was brought into one of 3M corporate laboratories and in a couple of months I was onboarded to the dental division. I started working on that program and within couple of years I ended up transitioning over into the division and I've been here ever since. So, my full-time career started in 3M in the beginning of 1998 and I'm coming up on 20 years here.



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Is there anything special about 3M that you have experienced from the very beginning?

Definitely it is the team spirit and ongoing cooperation. This enormous collaboration is the key to everything that we do. Nothing happens here in a vacuum. The culture within 3M is a little different than in a lot of other companies. There is very open collaborative work that goes on. Of course it is not about “protectionism” of particular technology, or particular type of product, or science, or discovery – anything that’s found within a company can be used by everyone else within 3M. We generally have a rule of about “three phone calls”. If you don’t know who the expert is in the particular area, that two or three phone calls will get you to the right person.

Filtek Ultimate Universal Restorative – was also developed in such a scientific, cooperative environment?

Yes, the entire Filtek Ultimate Universal Restorative product was developed collaboratively, with some of our colleagues from the corporate labs. Our filler technology really started from a collaboration between some of the scientists in our laboratory, scientists in the corporate labs, as well as some of the engineers in our pilot facility. We tried to figure out how to make and work with all of these types of clusters and nanoparticle materials that really make the product what it is.

Have you always been engaged in the projects related to the nanotechnology?

It is actually kind of interesting story. I’d been working sort of on the fringes of nanotechnology, when I started to work, because I was interested in it. Shortly after I moved over to the division here, 3M announced the acquisition of the ESPE Company, which had a mirror program in Germany to the one I was working on. Very quickly our two teams were combined for the purpose of more effective knowledge sharing. The decision was made to transfer the development of that program to our laboratories in Germany. Since I’d been working on the nanotechnology from the beginning as a side, or 15% effort, I was allowed to explore beyond what the original nanotechnology team were first starting to play with. As a result, we’ve now managed to expand our Nanotech Platform, as we call it, into probably a dozen or more products, that are divided into various product categories. So, we not only utilized Nanotech within Filtek Ultimate Universal Restorative, but also across a whole series of different products.

What was your contribution to the development of various nanotechnology-based products?

First of all, I was the lead developer of Filtek Ultimate Universal Restorative and spent a lot of time doing that. But, in one way or another, I have had a chance to contribute to probably virtually every product that had nanotech within it. I’ve also developed some of the raw materials that are used to formulate the products. With some other products, I basically provided technical guidance to some of the other scientists that were working on developing those products.

What role does the ‘true nanotechnology’ play in the Filtek Ultimate Universal Restorative?

The “true nanotechnology” is at the heart of the science and technology being used in the Filtek Ultimate Universal Restorative. The key to this product is what we call “cluster technology”, which really differentiates it from other composite materials. We’ve got different types of fillers in that composite material and the nanocluster makes up the majority of the filler. Within it we also have discrete nanoparticles. Other composites on the market will have the nanoparticle portion, but not the clusters. In Filtek Ultimate Universal Restorative the cluster itself is a unique structure that is synthesized from the bottom-up. Because clusters in Filtek Ultimate Universal Restorative are built with small nanoparticle building blocks, they will all break down in a very controlled manner. So, instead of having a particle that will pluck directly out of the matrix, these clusters will start to break down in a very controlled, very specifically designed way. Thus, instead of leaving a big hole behind in your composite as it starts to wear, you end up with something that’s very, very smooth. It allows the surface of the composite to maintain gloss and ultimate, optical, polished aesthetics.

How did the process that led to inventing Filtek Ultimate Universal Restorative look like? Where there any milestones on the way?

The genesis of what ultimately became Filtek Ultimate Universal Restorative goes all the way back in the late 90s. The entire development process took about 10-12 years, to go from the first concepts to the final product in a form that it is in today. There was an enormous collaborative effort between some of the scientists in our laboratory, our corporate labs and individual scientists, which led to inventing the first Filtek Supreme. Throughout the years, it went through a couple of iterations, related e.g. to the shade of the material. Then, in the mid 2000's we started extensive work aimed at increasing the performance of the material. It is when I got involved more heavily in the supreme line. We ended up really going through and figuring out how we could improve our polish, polish retention and some of the handling and aesthetic characteristics even further. That ended up leading to what became Filtek Ultimate Universal Restorative, which was launched in 2010.

Were there any challenges or issues you had to face along the Filtek Ultimate Universal Restorative development process?

There are always issues that you end up running into in product development. Some of them are technical in nature, some of them are business-related. When it comes to Filtek Ultimate material, it was incredibly complex system. Thus, we had to sort out many issues somewhere along the development. First of all, we were trying to figure out how do we take something from where it was in the original Filtek Supreme, and make it into a much more aesthetic material in terms of its polished gloss and how to better maintain that gloss over normal wear and use. Thanks to a tight collaboration with our corporate colleagues, manufacturing facility and our pilot facility we managed to figure out how we could make these fillers even better than the previous generation. It allowed us to reach high gloss and maintain it over time.

What are the main improvements which contribute to the performance of Filtek Ultimate Universal Restorative?

The significant improvements were around the fillers and how we put everything together. In general, we figured out how to make the cluster do its job better. So, it's designed to break apart a little more easily than it did before. It leaves a much smoother surface and smaller holes behind in the surface of the composite as it wears. As a result, when the light hits it, it doesn't scatter nearly as much and it looks very smooth and glossy. It allows the material to achieve good-looking and long-lasting natural aesthetic effects.

Were dentists also involved in this development process?

Yes, absolutely. When we get to a certain point within our projects, we will always get input from our customers and make sure that we find out what they like and what they don't. What we found is that they really like the polish and the aesthetic characteristics that Filtek Ultimate Universal Restorative gave them. Moreover, we got to know that dentists very much appreciate the handling of the material and the ability to manipulate it, shape it, sculpt it – do what they need to do. In addition to that, they immediately notice how the material looks, how it polishes, what is the match with adjacent teeth and so on. The next phase was the field evaluation, when Filtek was tested by dentists. We put the product into their hands to be placed in thousands of restorations. Then, we got this feedback in our hands to make final improvements. Eventually, the product was launched.

Things you do every day at work directly affect people's life. How do you feel about your job?

For me it is not just "a job". It is something far more, when I consider that I work on something that's making people's life better. This product has literally been put into hundreds of millions restorations around the world. When it comes to the entire Filtek line – it's over a billion restorations at last estimate. For me it is very important, but at the same time, it's also a little humbling when you start to think about the enormous scale of use. You know, it's in my own mouth, it's in my children's mouths and that's something you can say: "Look, this is improving the quality of life for people, makes them feel better about themselves, gives them a little more self-confidence and a smile they can be proud of".

What drives you as a scientist to keep on searching and working on Filtek?

Normally it is not like I am working on only one single product all the time. I deal with a number of different things, which keep me interested and fresh. Apart from Filtek, I worked for the whole host of other products over the years. What really drives me is the discovery. You have those „Aha!“ moments, when you are conscious that something has never been done before and is a brand new thing. In research and development you have to have a tolerance for failure, because 99% of the experiments that you try won't work. So, getting into that „Aha!“ moment is very rewarding. The second driver that is equally rewarding for me, is that amazing feeling when the product finally launches, goes out the door and starts being used for the first time. It's something you have worked on and what has evolved from its genesis on your benchtop.

How Science. Applied to life™ attitude is connected to your work in 3M?

3M is science & technology- based company. Without that – we don't exist. Basically our whole push throughout the history of the company is to innovate, to invent and to commercialize. Then, we take what we've earned from that and reinvest it back into doing something else, or doing an improvement, or doing the next thing. As we are in the healthcare business, we are trying to make people's lives better. It would not be possible, if we had not been given a certain level of freedom to operate. The early CEO of 3M, William L. McKnight, promoted the following attitude– to hire good people, give them a freedom and trust them to do the job that you hired them to do. My small contribution to that is work with products that are used in people's mouths, making materials that end up restoring form, function and hopefully beauty as well. Part of the reward of the job is in creating a situation where people are not in pain and not afraid to smile without embarrassment or self-consciousness.

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