Q&A with Dr. William Chen

Dr. William Chen is an IEEE Life Fellow, an ASME Fellow, a Fellow of ASE Group, one of the world's leading companies in semiconductor packaging and test, and a prominent leader in the packaging community since his early years at IBM. He is a former president of the IEEE Components, Packaging and Manufacturing Technology (CPMT) Society, as which the IEEE Electronics Packaging Society (EPS) was formerly known. Dr. Chen was accorded the 2018 IEEE Electronics Packaging Award in recognition for his pioneering contributions to the field—from research and development through industrialization—and for his leadership in strategic roadmapping efforts in heterogeneous integration. Here, Dr. Chen speaks to the revolutionary developments in electronics packaging over the last decades and looks ahead to the innovations on the horizon that most excite him.

Why is now the right time for heterogeneous integration?

> In the simplest terms, heterogeneous integration is driven by the fact that all electronic products, serving consumer and beyond, comprise many different components involving diverse technologies from a broad spectrum of ecosystem players. I am quite sure that you have a smartphone, a smartwatch, and a laptop. Maybe you also have a smart assistant at home. You may even have a robot that cleans the floor for you. All of these involve different technologies from different companies. So the big challenge becomes the integration of all these components together to achieve very specific functional and performance requirements. In this sense, the market—the demand of the consumers, you and I, all of us—has become the driving force behind the fast and disruptive changes in our industry, and subsequently the growing importance of electronics packaging.
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> It used to be that the leading industry driver was to build the most advanced computer. That's the original premise that we had—we all wanted to make computers go faster and faster. That was our world 10 or 15 years ago. Today, our world is changing dramatically, as we are now using electronics in so many life-changing ways, given the constant stream of evolving functions and applications. Electronics are deeply embedded in the fabric of our societies and everyday life. Heterogeneous integration is playing an instrumental role, because it empowers creativity, innovation and collaboration across our industry, from large companies to startups to academia to research institutes to engineering students.

At what point in your career did you see that this was the way that the industry would be progressing?

There's always hindsight; many of us look back and say, "Oh, we should have known that!" In actual fact, the idea of heterogeneous integration and system-in-package (SiP) has been around for a long, long time, evidenced in the last sentence in the famous 1965 Gordon Moore paper who expressed his vision so well. But the reality is that progress has taken time, and ideas on how to implement heterogeneous integration as a comprehensive and structured technology have only gained prominence in recent years.

When I graduated with my first degree in London many years ago, I thought I knew everything. But following my graduate studies at both Brown and Cornell, my realization was that I knew a little bit of engineering very well, but the rest of it? I didn't know anything. I then went to work for a company called IBM and that is where I learned about the practice of engineering. I learned that it's just as important to know what you know as it is to understand what you don't know. My career at IBM set me on a path to expand my knowledge in those areas that I didn't know much about. I started as a mechanical engineer, and then I learned about electrical engineering, and then I learned about physics, chemistry, materials and interfaces. At every stage, what I didn't know was always primary in my mind and the motivation to gain as much knowledge as I could. While at IBM, I was extremely fortunate that I could reach out to other parts of the company, like IBM Research, and universities, as well as attend technical conferences. I learned the importance of collaboration across discipline lines and respect for people with different perspectives. I remember one very good professor who said to me, "Bill, you asked me questions about things that I thought were obvious, but these questions actually sparked an important research project later."

As the market changes, the requirements change, and the things I don't know are also changing. Homogeneous integration raised many, many important questions to which we do not have answers, and we are only now learning how to address them.

Could you please tell us about working across the different IEEE societies and engineers in the road-mapping part?

When we work on developing new technologies and developing new products, we all come with very different perspectives. But key to our success is how we interface with each other when approaching an issue. We consider how a physicist might look at it, how a chemist might look at it, how a mechanical engineer might look at it, and so on. Naturally, there are cultural differences

across different scientific disciplines. But for the sake of science and progress, we try not to view these differing perspectives as a culture clash. Rather, we prefer to view them as vigorous discussions, where science and progress always wins!

It was always extremely important for us to have these vigorous discussions. When you want to put a product into the field, the idea first comes in from design engineers. Then we go through developmental engineers, and, at that time, it is very important to understand predictive modeling so that we go through the thought process of the different mechanisms—physics, chemistry and so forth—that go into making a product. Predictive modeling is thinking through from the beginning of concept to manufacturing and out to the field. That is a very similar thing to developing this roadmap.

Developing the roadmap is looking into the future and asking, What is our vision? What do we know? What don't we know? Where are the roadblocks? What research and innovation is needed to overcome these roadblocks? But the further we look out into the future, the greater are the unknowns. As we collectively decide the important knowledge gaps and understand the roadblocks—whether we should overcome the roadblocks or maybe walk around them—we put these ideas out into the ecosystem so as to inspire vigorous discussions and productive research. I wish to paraphrase the title of Jack Kilby's Nobel Prize acceptance speech, "Turning Potential into Reality." This is fundamentally what the roadmap is all about—it is about turning vision into reality. (I recall that Jack Kilby was an IEEE member and an EPS member.)

What are some of the ways that you are most proud to see how IEEE EPS itself has grown?

I am very pleased that packaging engineering is recognized as a profession, and that although our engineering education may come from different disciplines, it is recognized that we absorb these different knowledge bases and move forward as our own profession. This is very gratifying. The mere fact that CPMT changed its name to the Electronics Packaging Society is both recognition and validation; it means that the whole ecosystem is coming together and packaging is recognizably playing a major role.

Further, the value proposition that packaging brings to the greater electronics industry is increasingly important. We are moving further away from the traditional business model, where semiconductor people worked exclusively with packaging people. Now, packaging people are working with systems people, again underscoring the importance of heterogeneous integration. Today, the electronics ecosystem is drawing closer and tighter, and the interfaces are

becoming less visible and distinct. We are seeing more of a wave of continuity. It is making the value proposition of packaging more important, and that, too, is very gratifying.

What's the thing that you don't know right now that you would like to learn more about?

That is actually a pretty long list. There are things that excite me in terms of building new products, and there are things that excite me in terms of learning something new—these are not always the same.

The interface between materials, interface between people, interface between different disciplines … that is always the most difficult thing. It's always most difficult to understand the boundary between the different sciences and the boundary between different businesses. In our profession, the interface is the question that we are always the opportunity and the challenge.

What’s something that genuinely has surprised you about your industry?

I am genuinely surprised by how fast things are changing. The speed of change is staggering—and only accelerating. It is so stimulating that it keeps me awake at night and actually makes my brain work harder.

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