Living life in full colour

Solar panels are becoming increasingly part of our everyday world, so ensuring they blend seamlessly into their surroundings is key. A good time then for us to discuss this issue and some possible solutions for color solar modules, with Sebastian Barth, Business Development Manager Electronic Materials, at Merck.

PES: Hello Sebastian and welcome back to PES. We have known Merck for quite some time, but maybe you can say something about your company for those who are not so familiar with you?

Sebastian Barth: Thanks. Merck KGaA, Darmstadt, Germany is a science and technology company active in the areas of life science, healthcare, and electronic materials. Within the electronics sector we also have our surface solutions business unit where we develop effect pigments and other innovative solutions.

PES: And this is also where your solar activities are based?

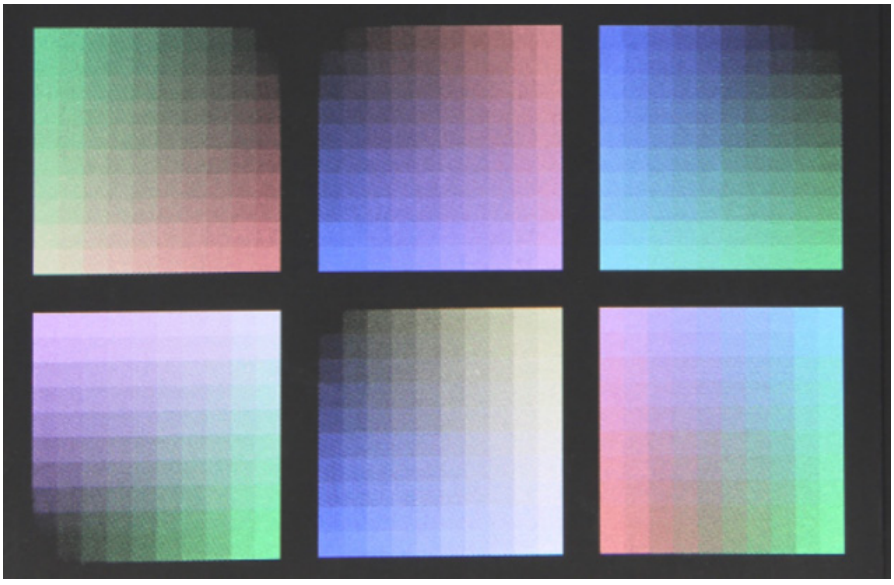
SB: Exactly. As you know Merck has been active in the BIPV market for many years. As we see coloring as one of the key trends and an enabler to bring more solar into buildings, we recently developed the application of special interference pigments to color solar modules and hide their appearance.

It basically combines the advantages of the dielectric layers and the digital print of pigmented layers on glass in one solution. It's called ColorQuant™. In short: you get bright colors at a low efficiency loss and with the flexibility of a printing process.

PES: This sounds very interesting. How exactly is your solution applied?

SB: We have developed two methods of application with partners, based on individual market needs. For customized projects as well as for a high coloring flexibility we developed an enamel-based paste which can be applied by screen printing, roller-coating, and spray coating. The paste is applied before the hardening process of the glass and melts during the hardening to become like an integer layer of the glass itself. This is a standard process known in the architectural industry and perfect for most BIPV projects.

Sebastian Barth

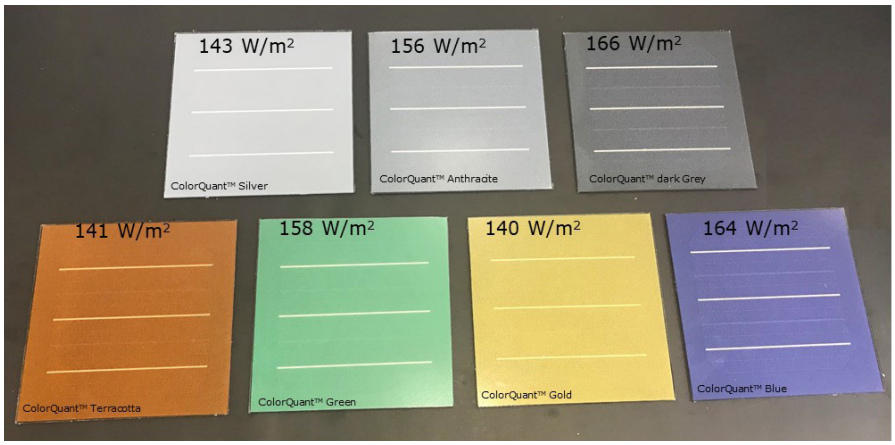


Graph 1 - Example of RGB based coloring: Upper part is mixing Green/Red, Red/Blue, Blue/Green; lower part are examples for Red/Green/Blue

For larger projects and the mass market for colored solar tiles we developed a solution based on a mass-colored front encapsulant. We can offer a colored POE as well as a colored EVA. For module producers this is easy to implement as the only thing that is replaced is a non-colored for a colored encapsulant.

PES: Are all RAL colors possible?

SB: We can cover a huge variety of colors. But as we work with reflection rather than absorption, we have some limitations. The RAL system is more relevant for a CMYK based coloring where you are working based



Examples of one cell solar modules with colors achievable by ColorQuant™. Uncolored reference module had 175 W/m²

on a white background. As a solar cell is always very dark, at least if the efficiency is high, we work with a RGB system like the human eye. This is shown in graph 1.

By mixing different amounts of red, green, and blue we can achieve a huge variety of different colors and color shades. If all are mixed in an equal way, we end up with white. This is the key difference to CMYK, where mixing all colors ends in black.

PES: Such a wide variety of colors is amazing. And they can be achieved with a low efficiency loss?

SB: The impact of the color on the solar module efficiency depends on the color itself, as well as on the glass used. Even white solar glass still has some color by itself, and this varies depending on the producer. In general, for darker colors the efficiency loss is lower compared to brighter colors. In graph 2 we show some examples for achievable colors and the corresponding module efficiency.

As a general limit the module efficiency should remain above 80% compared to an uncolored reference. This limit is for example in the case of bright gold, a tile like terracotta or a bright grey color. For all other colors like blue or green, the remaining module efficiency is above 90% of the uncolored reference. The visibility of the busbars of the solar cell on the picture is a good description of our technology. As silver reflects all light you see no color on the busbars by our ColorQuant™ technology. If you cover them black like it is done in most all black modules today, they completely disappear.

PES: Is it also possible to have a white colored module?

SB: We can achieve very bright grey tones. To get to a pure white nearly all the visible spectra must be reflected, which leaves a comparable low remaining module efficiency. As there are only limited projects which would accept such a high-power loss we haven't pushed for a pure white. But it also is challenging to get a full reflection of only the visible part of the spectrum.

PES: Do you see any specific colors being favored by the BIPV market?

Installation by Ertex Solar in Switzerland at Reichenburg

Rendering of installation from Sunovation

SB: Clearly yes. Although we have inquiries for all colors we offer, architects are frequently asking for grey. Especially the 'different shades of grey' we can achieve with our RGB coloring. This helps to give architects the freedom of design needed to implement solar modules into the facades of the future. Red and terracotta are also hot colors for rooftop integration.

PES: I can't wait to see how they would look in real life. Are there already examples on the market?

SB: After internal testing and development of our technology, we started launching back in 2020, at the same time as the pandemic. In retrospect, it was not the best timing for a market introduction of a new technology. But we still managed to get some first projects realized.

Ertex solar is one of the first module producers we have been working with. They have 17 years of experience in the BIPV market, with over 2,300 projects being realized, and we have already made some beautiful projects together and I am confident that we will have many more in the future.

We have also partnered with Sunovation, one of the market leaders in demanding and colored installations in Europe and known for beautiful solar designs. They recently launched their own collection with ColorQuant™. In picture 4 you can see a rendering of a building with a bright grey façade. I am very excited to see the first results very soon.

PES: Is the technology exclusive for Ertex and Sunovation?

SB: We are open to partner with any solar module producer or BIPV developer. Another advantage of ColorQuant™ is that it is easy to ship. We do not have to ship colored glass or final modules. With ceramic print the glass can be printed locally and the paste can be easily shipped internationally as it is not a dangerous good. For the encapsulant it is the same. Our only problem was that due to Covid-19 we weren't able to travel for two years.

PES: I can imagine. Covid-19 is a challenge for all of us. Besides the change in color, is there any other impact on the solar module, for example the lifetime?

SB: Besides changing the appearance and with this also the efficiency we do not see any impact on the solar module. We went through extensive testing regarding damp heat for over 2500 hours, as well as all other relevant tests and passed them all very well.

We also did extensive UV testing and did not see any fading of the color or any other problems. Besides that I can only see positive effects, like a slightly lower operational module temperature due to the reflection of part of the light. But we should see this when some more projects are tracked over time. Maybe I can give an update in the future on new projects.

PES: We would be happy to hear more. Thanks Sebastian.

SB: Thank you too.

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