Experimental and computational performance analysis of full-scale aesthetic BIPV systems

Solar energy technology is being increasingly used to generate the world’s electricity. The use of BIPV systems has been proposed as an alternative to generate renewable electricity while optimizing the built area of cities. Nonetheless, the aesthetic appearance of PV elements has traditionally been a barrier for their implementation. To tackle this, new techniques have been developed to change their appearance by altering their colours, textures and physical appearance.

The performance of different types of aesthetic layers on c-Si and CIGS PV panels was studied at a façade scale, and their results were extrapolated to different locations, orientations and conditions through a simulation study. Additionally, it was assessed whether existing PV simulation tools were suitable to estimate the performance of these systems. The results have shown that the performance losses are triggered by different variables such as the material, pattern coverage, thickness, color lightness, and the colour itself, having considerable effects in the light-generated current of the panels and the reflection profile of sunlight at different incidence angles. Furthermore, the relatively low performance drop of the studied panels makes them have potential to be used in high-rise buildings with low shadowing levels and a high vertical built area.

Figure 1: Variation of the energy production of a PV system simulated with a traditional PV simulation tool and using custom reflection profiles for different aesthetic layers at different latitudes and months of the year.

Figure 2: Scheme for optical losses of different aesthetic layers.