Photovoltaic cells, their separation and description

Design, Photography

Generally, photovoltaics can be grouped into first, second and third generation photovoltaics. First generation of photovoltaics are typically made from polycrystalline due to its vast availability and can achieve up to almost 28% of conversion efficiency. Monocrystalline are more effective but also can be more expensive. Second generation of photovoltaics are 100 times thinner than first generation photovoltaic panels and most are still made from silicon, amorphous silicon. Some are made from different materials such as cadmium telluride and copper indium gallium diselenide. Due to their thinness second generation photovoltaics acquired flexibility and can be laminated onto most surfaces of building construction materials such as glass, roof tiles, skylights, metal, polymer and all kinds of substrates. Refer to figure 1 for thin-film photovoltaic. However, second generation thin-film photovoltaics can only achieve within 10-20% of conversion efficiency. Third generation photovoltaic combines the best of both first – and second-generation achieving efficiency of 30-45%. They are likely to be made from materials apart from simple silicon. Ideally, third generation photovoltaics will be cheaper, more efficient and more practical compare to first- and second-generation photovoltaics.

Practical applications for thin-film BPIV have been explored in the past decades and have been used as integral part of the building exterior, structure, glazing/curtain walls and skylights/roof through various innovations and techniques.

In New York's Stillwell Avenue Station, thin-film photovoltaics have been panelized as a part of the skylights and structure of the roof, producing peak power output of 250kWp providing electricity generation, shelter and day lighting at the same time. However, building integration of thin-film photovoltaic technology is not limited to this general concept. The technology has much more potentials of providing weather protection, noise/sound barrier, thermal insulation, electromagnetic shielding, safety, pleasing aesthetic and modulation of daylight to receive higher light transmission with minimum solar gain within the space through skylight or architectural glazing curtain walls.

Another application of architectural successful building integrated thin-film photovoltaics in semitransparent facades can be found at Norway's Trondheim University of Science and Technology which comprises 192m2 of thin-film PV modules out of 445m2 double glazed building façade. This is an excellent example of multifunctioning building fabric which acts as thermal and acoustic insulation, modulation of daylight into the space via semitransparent façade with thin-film photovoltaics for energy generation, weather protection and pleasing building aesthetics. The combination of thin-film BIPV and self-cleaning façade will present a more effective construction as self-cleaning façade will lead to the more effective harnessing of solar energy by the thin-film BIPV and therefore increasing the energy generation. In many cases, the facades are also being cleaned by building management via scheduled cleaning.

As public awareness and understanding of global warming causes has been on the rise in current days, countries all over the world are trying to set initiatives and goals to achieve in maintaining the global temperature rise below 2°C in this century, Paris Agreement. Overwhelming responds from

194 parties has been made to Paris agreement and signed by November 2018. In search of the solutions, low carbon and renewable technologies are no doubt plays a major role in decarbonization pathways across energy systems.

Photovoltaic is considered one of the most sustainable and potent renewable and low-carbon energy systems. However, the area most often overlooked is how the photovoltaic modules are being made. The production process of photovoltaic modules commonly requires using Nitrogen Trifluoride which is essentially a cleaning agent used in clearing excess silicon from production chambers and has also been chosen due to its ability to clean quicker. Most of this chemical is cleaned away. However, a small percentage leaks into the atmosphere and offset within the first one-to-four months of PV modules life. Unethical businesses all over the globe will commence manufacturing of PV modules with little to no regards to the release of NF3 into the atmosphere, where NF3 is thought to be 17, 200 times more potent than carbon dioxide as a greenhouse gas, according to the U. N. Intergovernmental Panel on Climate Change. CF4, C2F6, SF6 and NF3 have global warming potentials 7390, 12200, 22800 and 17200 times higher than CO2. Refer to table 1 below for global warming potential of certain greenhouse gases and their lifetimes.

Currently, it is anticipated that photovoltaics panels to last 20-25 years with a small percentage of degradation. Mono and polycrystalline photovoltaic modules tend to degrade at about 0. 5%/year of its efficiency whereas thin-film photovoltaics tends to degrade faster. Refer to table 2 below for percentage degradation of PV modules.

Photovoltaic is no doubt one of the essential renewable energy systems of the future. Thin-film photovoltaics however, due to its contribution of NF3 into the earth atmosphere during and after its manufacturing processes and its achievement of lower energy conversion efficiencies, there is a possibility that mass manufacturing of thin-film photovoltaic would do more harm to the environment with the possibility of unethical business models. In addition, higher degradation rate of thin-film photovoltaics will result in shorter life-spam than its predecessors. Third generation photovoltaics on the other hand are likely to use materials apart from simple silicon which comprises multiple layers of different semiconducting materials and ideally it would be a lot cheaper, more practical and efficient than either first or second generation thin-film photovoltaics. With regards to the commitments made to the cause of reducing and mitigating global temperature rise below 2°C, photovoltaic technology should be refined into a more efficient and sustainable versions instead of letting our greed drives the businesses around the world with an under-refined technology that has minimal positive impact on the built environment industry.