Diffuse Reflectivity of Jinko PV module

PV modules are widely used in BIPV/BAPV/Roof-top projects, and there is more concern on reflectivity of PV modules than ever. There are two types of reflection, i) specular (mirror-like) reflection and ii) diffuse reflection. Specular reflection should be well considered, which, from basic physics knowledge, can reflect sunlight and be observed with potentially glare in a particular angle; While diffuse reflection (shown in Figure 1[1]) is always at a safe level.

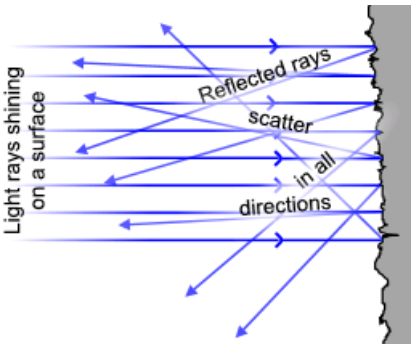

Figure 1 Diffuse reflection

Jinko PV module shows diffuse reflection due to ARC glass, texturing of own brand PV cell, etc. Integrating Sphere Tests were performed in PV lab with a Varian 5000 Spectrophotometer, which collect and measure all diffuse reflected energy of an incident light. Result is shown in Figure 2, with comparison of reflectance of module with/without anti-reflection coating (ARC).

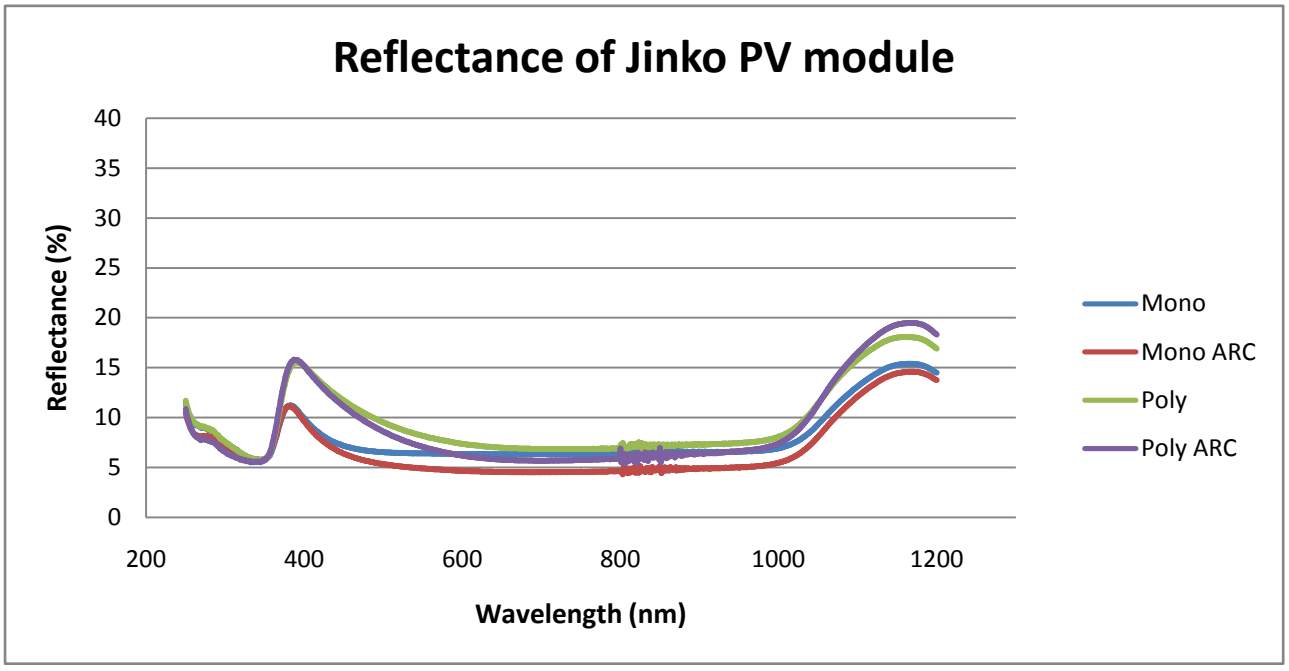

Figure 2 Reflectance on different wavelength, Integrating Sphere Test.

Diffuse Reflectivity Value (also called "Albedo Value") depends on the frequency range of radiation considered. Different incident spectrum will show different reflectivity value. We choose ASTM G173-03 reference spectral irradiance distribution[2] (shown in Figure 3), which is also defined in IEC60904-3[3], as the data for Reflectivity

[1] Picture quotes Wikipedia, the free encyclopedia. *http://en.wikipedia.org/wiki/File:Diffuse_reflection.PNG*

[2] SMARTS2 version 2.9.2 is the model used to generate the American Society for Testing and Materials (ASTM) terrestrial reference spectra for ASTM Standard G-173-03 "Standard Tables for Reference Solar Spectral Irradiance at Air Mass 1.5:

Value calculation[4].

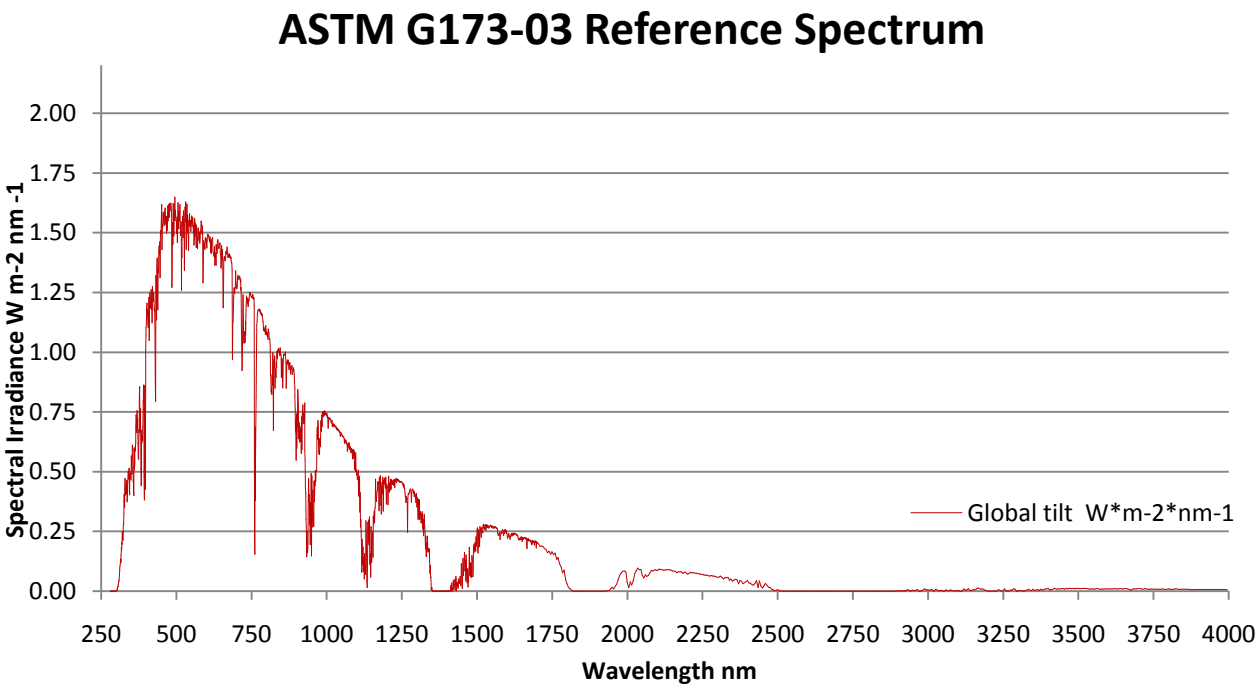

Figure 3 ASTM G173-03 Reference Spectrum

Above all, the Diffuse Reflectivity (Albedo) Value of Jinko PV module is,

Module Type	Mono	Mono (ARC glass)	Poly	Poly (ARC glass)
Diffuse Reflectivity (Albedo) Value	**6.74%**	**5.35%**	**8.79%**	**7.83%**

* Consider visible light from 380nm to 780nm[5];

* Extended measurement uncertainty of Diffuse Reflectivity (Albedo) Value = +/- 0.50%.

Direct Normal and Hemispherical for a 37 Tilted Surface".

[3] IEC60904-3, Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data

[4] The methodology of calculation complies with ISO 9050, Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors.

[5] ISO 9050:2003(E), 3.4.1, External light reflectance of glazing.