**Table 1.** Information on the three materials used in this study

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Code | Material type | Material image | Manufacturer, product usage, and price | Advantages |
| AC | White elastomeric acrylic painting |  | Nippon, 1 mm thickness, 18 kg used and 0.71USD m-2 | Resistant to cracking, high temperatures, and water |
| TPO | White thermoplastic polyolefin membrane |  | Hongchang Waterproof Material Co., Ltd., 1 mm thickness, 30 m2 coverage, and 18.88 USD m-2 | Weather-resistant, weldable, novel cool roofing and waterproof membrane materials, high tensile strength, long service life |
| SBS | Aluminum foil composite film covered styrene-butadiene-styrene bituminous membrane |  | Laishide, 3mm thickness, 30 m2 coverage, 3.14 USD m-2 | Waterproof, insulating, convenient installation, inexpensive, resists deformation, puncture resistant |

**Figure 1.** (a) Overhead view of the experiment site, including (b) CK area on the concrete roof, (c) AC area after 2nd recoating white elastomeric acrylic painting, (d) TPO area with white thermoplastic polyolefin membrane, and (e) SBS area with aluminum foil composite film covered styrene-butadiene-styrene bituminous membrane.

**Figure 2.** Instrument configuration in the experiment site (the shaded area denotes the detection range of the CNR4).

**Figure 3.** The diurnal variation of the difference in surface temperature between the cooling roof materials and the concrete roof (Δ*Ts*). (a) during the whole time (n=49), (b) during maximum air temperature higher than 35℃ (n=20), (c) during clear skies (n=10), and (d) during cloudy days (n=8) from Jun. 28 to Aug. 15, 2017.

**Figure 4.** The relationship of the temperature differences (Δ*Ts*) and the albedo (α) in summer (Jun., Jul., and Aug.) from 2017 to 2018. Temperature differences (Δ*Ts*) refer to the difference in surface temperature between the cooling roof materials and the concrete roof.

**Figure 5.** The relationship of the temperature differences (△*Ts*) and the daily solar radiation (*Qs*) in the summer (Jun., Jul., and Aug.) from 2017 to 2020. Temperature differences (Δ*Ts*) refer to the difference in surface temperature between the cooling roof materials and the concrete roof.

**Figure 6.** Monthly total precipitation and average concentration of PM10 in Nanjing from Apr. 2017 to Oct. 2020.

**Figure 7.** Changes in the albedo of AC painting, compared with the concrete roof. (a) and (b) are the photos before and after AC was recoated on Jun. 8, 2017, respectively. (c) is the result after the first application; (d) is the result after the repainting. The line is the linear regression between the albedos and the days after AC was repainted on the roof. The slope and intercept of the regression equation represent the decay rate and initial albedo of AC materials.

**Figure 8.** Changes in the albedo of SBS and TPO materials, compared with the concrete roof, for nearly 4 years in Nanjing. (a) and (b) are the photos of SBS and TPO used for a period, respectively, which were taken on Jun. 27, 2017, before cleaning. (c) and (d) are the change of albedo (α) over a long period. The solid lines are the linear regression between the albedos and the days after the cooling materials were coated on the roof. The slopes and intercepts of the regression equation represent the decay rate and initial albedo of cooling roof materials.

**Figure 9.** The relationship between the seasonal variation of albedo and monthly average PM10, the monthly total precipitation from 2017 to 2020.