# A novel technique for the production of cool colored roofing materials

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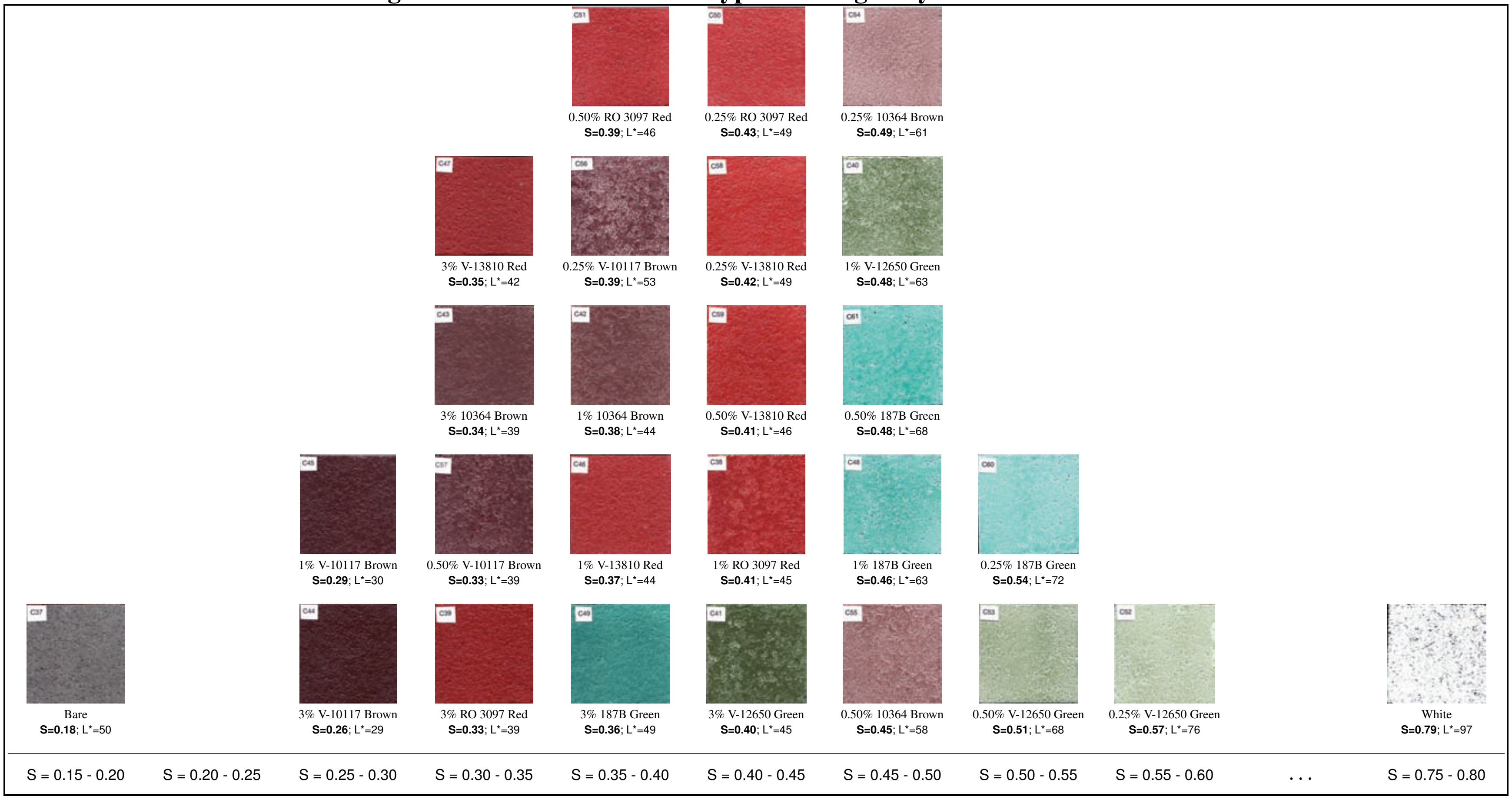
## ABSTRACT

The widespread use of solar-reflective roofing materials can save energy, mitigate urban heat islands and slow global warming by cooling the roughly 20% of the urban surface that is roofed. In this study we created prototype solar-reflective nonwhite concrete tile and asphalt shingle roofing materials using a two-layer spray coating process intended to maximize both solar reflectance and factory-line throughput. Each layer is a thin, quick-drying, pigmented latex paint based on either acrylic or a poly(vinylidene fluoride)/acrylic blend. The first layer is a titanium dioxide rutile white basecoat that increases the solar reflectance of a gray-cement concrete tile from 0.18 to 0.79, and that of a shingle surfaced with bare granules from 0.06 to 0.62. The second layer is a “cool” color topcoat with weak near-infrared (NIR) absorption and/or strong NIR backscattering. Each layer dries within seconds, potentially allowing a factory line to pass first under the white spray, then under the color spray.

We combined a white basecoat with monocolor topcoats in various shades of red, brown, green and blue to prepare 24 cool color prototype tiles (Figure 1) and 24 cool color prototypes shingles (Figure 2). The solar reflectances of the tiles ranged from 0.26 (dark brown; CIELAB lightness value $L^* = 29$) to 0.57 (light green; $L^* = 76$); those of the shingles ranged from 0.18 (dark brown; $L^* = 26$) to 0.34 (light green; $L^* = 68$). Over half of the tiles had a solar reflectance of at least 0.40, and over half of the shingles had a solar reflectance of at least 0.25. This process can meet solar reflectance targets (e.g., $S \geq 0.25$) with products that are significantly darker in appearance than those colored with conventional techniques, such as cementitious slurry coatings on gray-cement concrete tiles or single-layer ceramic coatings applied to gray granules.

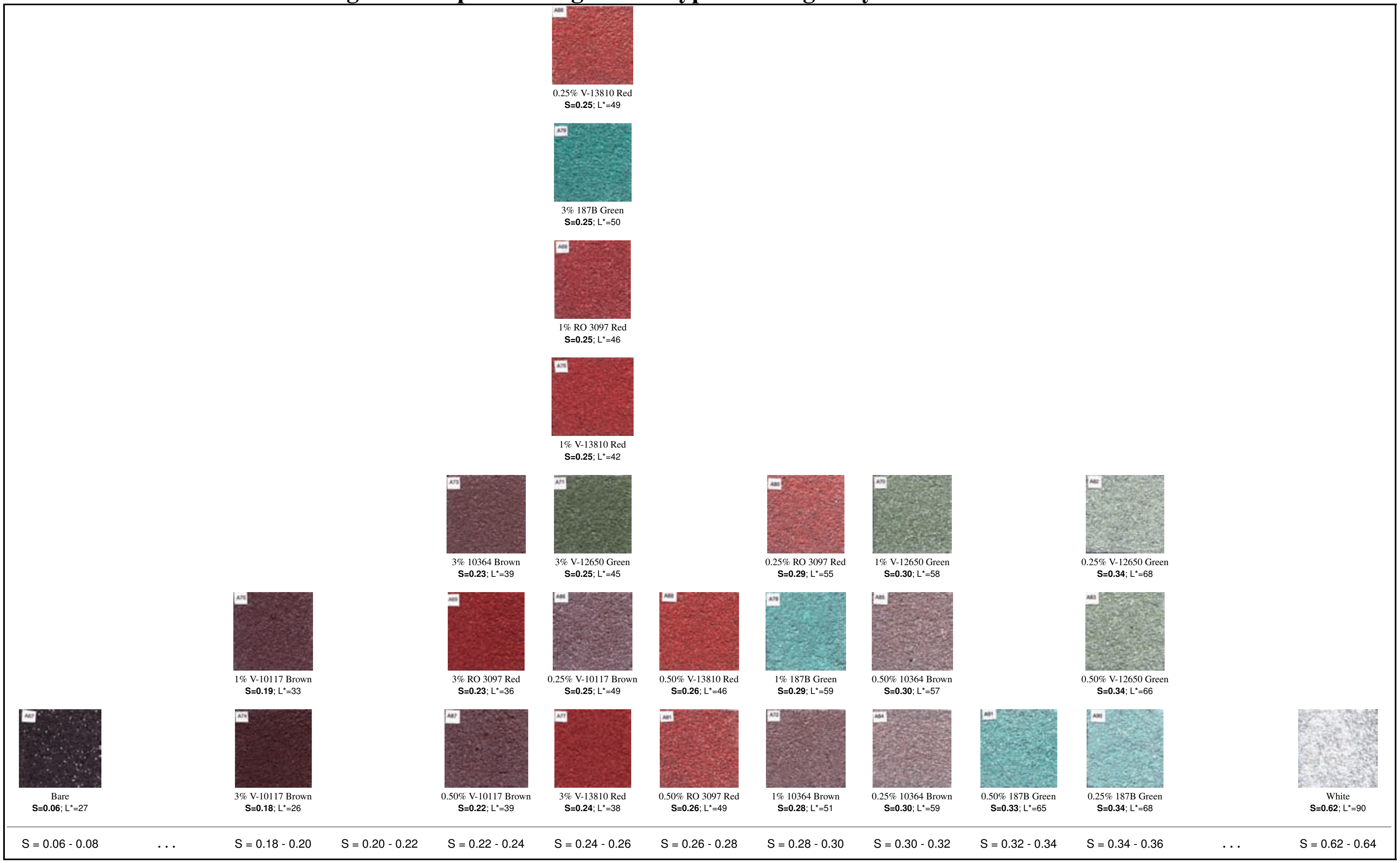
We estimate that increasing the thickness and NIR reflectance of a tile’s white basecoat could increase the tile’s solar reflectance by up to 0.04 if the cool color topcoat has high NIR transmittance (0.80), or by up to 0.02 if it has moderate NIR transmittance (0.40). We also estimate that the solar reflectance of each shingle prototype produced in this study could be increased by between 0.02 and 0.12 by using about 50% more material in its white basecoat and its color topcoat. Whether this would make each shingle lighter in appearance would depend on how well the thicker color topcoat hides the thicker white basecoat.

**Figure 1. Concrete Tile Prototypes Arranged by Solar Reflectance**




S = solar reflectance; L* = lightness.

**Figure 2. Asphalt Shingle Prototypes Arranged by Solar Reflectance**

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