Multifunctional Energy-Storage and Luminescent Material for Sustainable and Energy-saving Lighting for Tunnels (LUMA)

CHINA

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Problem?

A: Fire escape?

B: Energy saving lighting?

C: Air Quality? Dusty?

D: Traffic Safety?

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Road tunnel kilometers increase at annual rate of 10%!

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Principle of illumination

Valence Band

\[ \lambda = 480 \text{nm} - 580 \text{nm} \]

UV or Visible light

Conduction Band

\[ V \]

\[ V_C \]

\[ \text{Sr}_2\text{AlO}_4 \text{Double-doped material electron capture and captured luminescence mechanism} \]

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Product and Technology

Coating of LUMA

Road marking of LUMA

Raised pavement makers of LUMA

Delineater of LUMA

The reflective outline ring of the tunnel

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<table>
<thead>
<tr>
<th>No.</th>
<th>Item Name</th>
<th>Authorization or Application Number</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A Design Method for Auxiliary Road Tunnel Lighting Based on Multifunctional Energy-Storage and Luminescent Materials (Patent Pending)</td>
<td>201510974296.1</td>
<td>China</td>
</tr>
<tr>
<td>2</td>
<td>A Green Lighting Method for Road Tunnels with Effective Utilization of Light Energy (Patent Pending)</td>
<td>201610945093.4</td>
<td>China</td>
</tr>
<tr>
<td>3</td>
<td>Lighting without Lamp Facilities based on Natural Light and Automobile Light (Patent Pending)</td>
<td>201711442283.5</td>
<td>China</td>
</tr>
</tbody>
</table>

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Application Design

Coating
thickness 380 μm

Tunnel reflective aura
thickness 2 mm/width 150 mm @80–200 m

Midline of tunnel

Delineater
@6–12 m

Delineater
@6–12 m

Raised pavement makers
@6–9 m

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Application Design

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Effect-----Brightening and brightening

Coated with traditional coating

Coated with LUMA

Brightness > 25%

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When LUMA is set at the tunnel opening, and there is less contrast of light inside and outside the hole (exit). So it helps to reduce traffic accidents!

**Effect ---- Eliminate the "black hole" and "white light"**

(a) “Black hole” phenomenon  
(b) “White light” phenomenon  
(c) “Black hole” eliminated  
(d) “White light” eliminated

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Significantly improved illumination uniformity reduces the probability of accidents caused by lack of visual reference illumination.
Compensate light source gap and increase visual distance

Test for spectrum wavelength change of light sources in the spaces with different wall surfaces

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Visual effect in the same distance with light sources having different color temperature and lighting brightness

(a) 5000K, 80Lx
(b) 2500K, 80Lx
(c) 5000K, 410L
(d) 2500K, 410L

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1) No other light source, Coated with LUMA, Increase the visible distance of smoke penetration by more than 3m.
2) In the event of a fire, its time-delay luminescence and smoke penetration ability can effectively guide escape.

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Effect----High stain resistance

High stain resistance: Compared with traditional tiles and other coatings, LUMA has higher stain resistance and is easier to clean, ensuring clean tunnel walls and easy maintenance management.

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Effect----LUMA decorates the tunnel and relieves psychological stress

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Green pathway

Show cases --- **Pathway in countryside**

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Use LUMA to create a green tour, and to beautify the road environment while playing the role of no-lighting guidance!

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Rare earth luminescent materials and common fluorescent materials is different.

Brightening and auxiliary emergency lighting, release negative ions, light wave smoke, pollution resistant.

Save electricity costs of 150 million US dollars per year; ensure operation safety, reduce safety accidents; purify air in tunnels and reduce haze.

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Benefits and social impact

Saving of energy cost (estimated potential of 1.5 billion dollars just in China)

Purify the air and reduce smog inside tunnel

LUMA improves tunnel operation safety and reduces the likelihood of accidents

Ensure the visibility distance for escape greater than 3 meters in case of fire

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THANKS!

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