

A close-up photograph of a motorcycle, focusing on the fuel tank and engine area. The fuel tank is a bright, glossy orange. Below it, the engine is visible, featuring a light blue circular cover with an orange ring. The background shows more of the motorcycle's bodywork, including a white stripe on an orange section. The overall lighting is bright, highlighting the metallic and painted surfaces.

RheoLighttm

Crystal Glass Pigments

SHAPING THE FUTURE OF MOBILITY

Impact of color
in road safety

INSIDE STORY
Visibility Label for
safer mobility colors

RHEOLIGHT
improves black
visibility for ADAS

Twin Flop,
safety made beautiful

INK INVENT™
— RheoLight™ Crystal Glass Pigments —

SHAPING THE FUTURE OF MOBILITY

RheoLight Crystal Glass Pigments are specifically designed for the mobility industry. They refract light in a unique way not found in any other product on the market. RheoLight opens a new world of functional color shades in mobility.

INCREASED HUMAN AND ADAS VISIBILITY

RheoLight significantly improves visibility for humans and enhances sensor detection reliability for Advanced Driver Assistance Systems (ADAS). This innovation sets a new safety benchmark for exterior design and mobility industry standards.

FUNCTIONAL AND ADDICTIVE BEAUTIFUL

Color stylists can create stunning metallic and pearlescent color shades that are truly unique and functional. The percentage of RheoLight in a color formula provides tunable control over the desired effect. This allows for the addition of a luxurious sparkle and light effects that captivate the eye, continually surprising the senses.

WHAT ARE CRYSTAL GLASS PIGMENTS?

RheoLight, the world's first Crystal Glass Pigment, represents a groundbreaking class of effect pigments characterized by their unique physical and chemical structure: perfectly round Crystal Glass Microspheres. Much like the properties of diamonds, RheoLight enhances and intensifies light direction and reflection, delivering strong specular and return reflections under all lighting conditions.

HOW SMALL CAN IT BE?

Amazingly, just 1 gram of RheoLight CSTL (automotive OEM grade) contains 12 billion perfectly round Crystal Glass Microspheres, each with an average particle size of 5 microns. RheoLight mobility grades are available as solvent- and water-borne stabilised liquid dispersions, enabling seamless formulation with other effect pigments.

RHEOLIGHT MOBILITY GRADES

CSTL Particle size D50 - D90	5-8 micron
CTL Particle size D50 - D90	7-11 micron
CSL Particle size D50 - D90	10-16 micron

Particles in size range	> 99%
Optical properties	Isotropic
Color	Colorless
Luster	Adamantine
Diaphaneity	Transparent
Density	1.9 g/cc ± 0.3 g/cc
Refractive index	2.1
Melting point	> 1.200°C

IMPACT OF COLOR IN ROAD SAFETY

The color of a vehicle plays a crucial role in its visibility and overall road safety. Studies consistently show that white is the safest color, associated with a 12% lower accident risk compared to darker colors like black, which tend to blend into their surroundings, especially at night.

HIGH ACCIDENT RISK DUE TO REDUCED VISIBILITY

Black vehicles face a 47% higher risk of accidents at dawn, dusk, and night due to poor visibility. In contrast, bright colors like white, yellow, and orange improve visibility, making them significantly safer choices. These findings highlight the critical role of high-visibility colors in preventing accidents and improving road safety.

ENHANCING SAFETY FOR ALL VEHICLES

With RheoLight's advanced light-reflecting properties, color stylists and formulators can significantly enhance both human eye visibility and the reliability of ADAS systems. Even unsafe dark metallic and pearlescent colors can be enhanced to achieve greater visibility and improved safety.

COLOR'S HIDDEN SAFETY IMPACT

More than half of bicyclist fatalities take place during dawn, dusk, or nighttime. On weekdays, 21% of fatal crashes occur between 6:00 p.m. and 8:59 p.m., rising to 23% on weekends during the same period. Choosing high-visibility colors can greatly reduce the risk of accidents and ultimately save lives.

DARK COLORS HAVE

47%

HIGHER RISKS OF
ACCIDENTS



Sources: Road Safety Commission Vehicle Safety, Government of Western Australia

VISIBILITY LABEL FOR SAFER MOBILITY COLORS

The Visibility Label is an innovative rating system designed to evaluate the visibility of coatings in the mobility industry. It ranks the human visibility of colors from A (highly visible) to G (barely visible) under low and dark lighting conditions. It also includes an additional visibility score for LiDAR and Computer Vision (camera), which are used in ADAS (Advanced Driver Assistance Systems) for autonomous driving.

Human Visibility

Measures a color's brightness on a very dark, overcast day (100 Lux) to assess its visibility to the human eye under low-light conditions.

Computer Vision

Evaluates a color's brightness, averaged across a very dark, overcast day (100 Lux) and the end of civil twilight (3.2 Lux), to determine its detectability by Computer Vision (camera) systems.

LiDAR Visibility

Assesses how effectively a color reflects LiDAR signals, essential for the accurate operation of autonomous driving systems.

Full Object Visibility

Over 99% of visible objects are not at a 90° angle to the observer. This parameter measures the contribution of angled surfaces to human eye visibility.

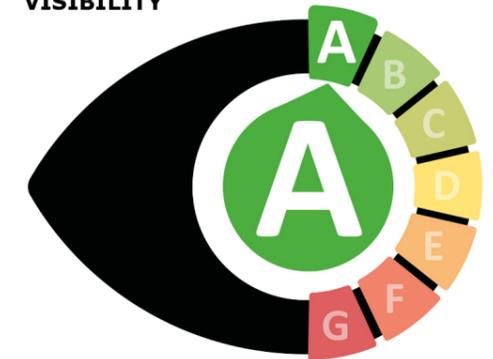
Twilight Visibility

Rates a color's visibility in low-light scenarios, such as the end of civil twilight (30 minutes after sunset), when observed under very dark conditions (3.2 Lux).

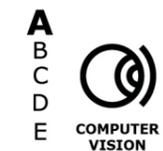
More info at www.VisibilitySavesLives.org



HUMAN VISIBILITY



TEST ID: 0167444



NOW YOU SEE ME

At night, RheoLight's billion Crystal Glass Microspheres, greatly enhance visibility for both the human eye and sensors. The Visibility Label rating system demonstrates a significant improvement, elevating human visibility from E to A for the Vespa scooters shown. Additionally, LiDAR detection increases by 140%, and Computer Vision reliability improves by 21%. These advancements also enhance AI accuracy, enabling more precise decision-making in ADAS autonomous driving systems.

COLOR STYLING AND VISIBILITY CONTROL

The concentration of RheoLight in a color formulation determines how much light is reflected. The Vespa scooter on the right, enhanced with RheoLight in its original metallic grey hue, stands out brilliantly in low-light conditions illuminated by car headlights. In daylight, it closely matches the Vespa scooter on the left, which retains its original metallic grey color. RheoLight empowers color stylists to improve the safety of darker shades while preserving their original aesthetic appeal.



THE DIFFERENCE IS CRYSTAL CLEAR

VisibilitySavesLives.org evaluated 10 popular metallic and pearlescent mobility colors, both with and without RheoLight. The difference is striking, not only for human eyes in low and dark lighting conditions but also for ADAS autonomous driving systems. Even colors traditionally considered safe, like white, orange, and yellow, become noticeably more visible and safer with RheoLight.

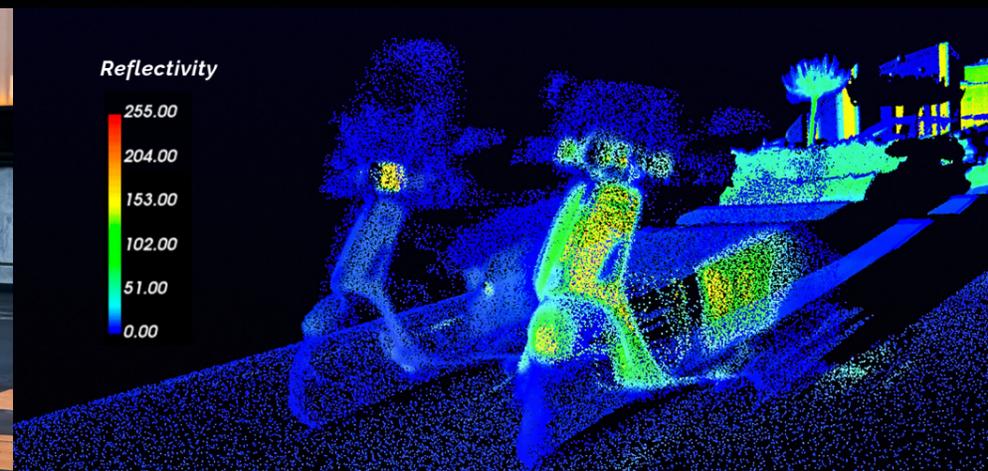
HUMAN VISIBILITY LABEL SCORES

	Color +RheoLight	Original Color
Silver	A	B
Blue	B	D
White	A+	A
Grey	A	E
Green	B	D
Red	D	F
Orange	A	B
Purple	A	B
Yellow	A+	A
Gold	B	C

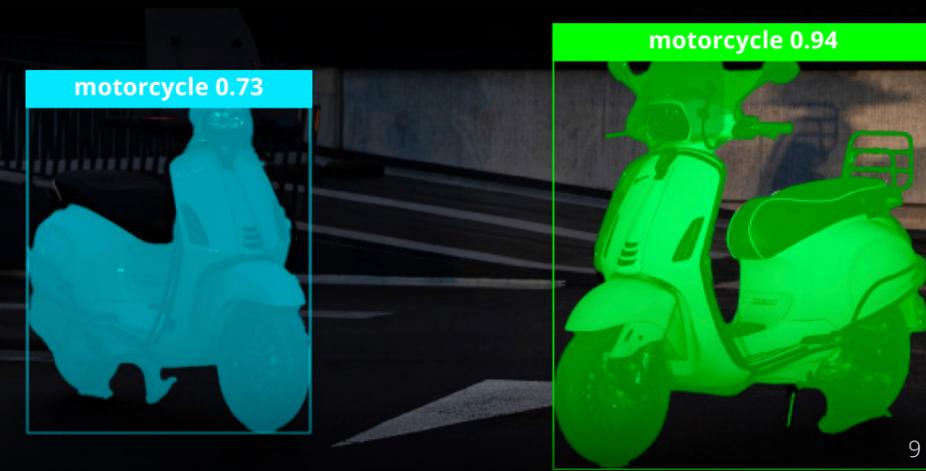
METALLIC GREY VESPAS.
IDENTICAL COLOR SHADES BY DAY



LIDAR REFLECTIVITY SCORE.
140% MORE VISIBLE



COMPUTER VISION (CAMERA).
21% INCREASED RELIABILITY



AESTHETIC SAFETY

Black motorcycles are among the most hazardous vehicles on the road, primarily because of their near-invisibility—especially after dark. At night, they vanish into the shadows, and during the day, they blend seamlessly with blacktop roads, posing a serious safety threat to all road users. With the increasing popularity of two-wheeled mobility solutions, the alarming rise in nighttime traffic accidents highlights the pressing need to enhance visibility and make our roads safer for everyone.

SMOKEY BY DAY, BRILLIANTLY VISIBLE BY NIGHT

The smokey grey color of this Harley Davidson Night Rod Custom and helmet was enhanced with 21% RheoLight added to the original formula. This adjustment utilizes the reflectivity of RheoLight, activated by car headlights, dramatically improving visibility. Human eye visibility increased by 350%, while LiDAR and Computer Vision (camera) detectability for ADAS systems rose by 400%. During daylight, the tuned color closely resembles the original color.



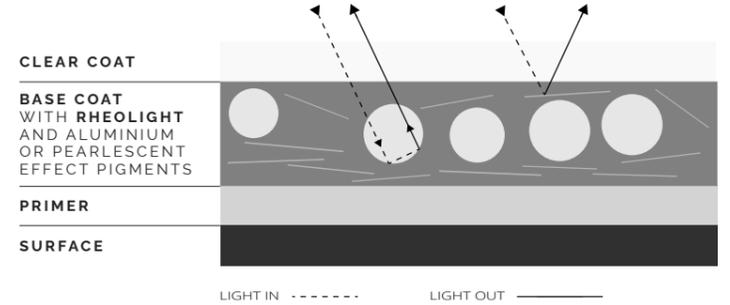
EVERY COLOR SAFER FOR ADAS

We evaluated four hard-to-detect metallic and pearlescent automotive color shades using LiDAR and Computer Vision (camera) technology. The testing protocol compared panels of the original color with varying percentages of RheoLight CSTL Mobility Grade added to the color formula, all finished with a gloss topcoat.

The percentage of RheoLight in the formula influence the level of improvement achievable for Computer Vision (camera) and LiDAR sensors in ADAS autonomous driving systems.

Testing hardware: LiDAR: Livox HAP (TX) Laser (905 nm).
Light: NANLITE Forza 60B. Camera: Canon EOS 7D Mark II,
Lens; EF-S18-135mm f/3.5-5.6. Motion Controller: Syrp Genie Mini II.

TWIN FLOP, SAFETY MADE BEAUTIFUL



Billions of RheoLight Crystal Glass Microspheres, combined with metallic and pearlescent effect pigments, create a retro reflection in the coating. This distinctive Twin Flop effect enhances LiDAR and Computer Vision camera signals. Additionally, it improves the visibility of curves and the true dimensions of a vehicle, making ADAS autonomous driving systems more effective and reliable.



RED +9% RHEOLIGHT
ADAS DATA IMPROVEMENTS

LiDAR +120%
Computer Vision +120%

SILVER +10% RHEOLIGHT
ADAS DATA IMPROVEMENTS

LiDAR +140%
Computer Vision +140%

GREY +7% RHEOLIGHT
ADAS DATA IMPROVEMENTS

LiDAR +130%
Computer Vision +130%

BLUE +18% RHEOLIGHT
ADAS IMPROVEMENTS

LiDAR +150%
Computer Vision +160%

RHEOLIGHT IMPROVES BLACK VISIBILITY FOR ADAS

Statistics reveal that black is the most hazardous color for vehicles in motion. Due to its reduced visibility, black cars face a 47% higher risk of accidents at dusk or dawn and a 12% higher risk during daylight hours compared to white vehicles. LiDAR and camera sensors in ADAS (Advanced Driver Assistance Systems) encounter challenges in accurately detecting black vehicles. However, incorporating RheoLight into black and other dark-colored metallic or pearlescent formulations significantly boosts their detectability. By providing better responses from LiDAR, Computer Vision (camera), and AI algorithms, RheoLight enables ADAS to create a safer driving environment for autonomous vehicles.

THE BENEFITS OF RHEOLIGHT IN COLOR STYLING

Colors become progressively harder to detect at steeper observation angles, with black and other dark metallic shades presenting major visibility and safety challenges. RheoLight enables you to maintain creative freedom in color styling while enhancing ADAS visibility. Its innovative 180-degree retroreflection creates a striking twin-flop effect, adding a luxurious dimension to darker colors and enhancing visibility, all without compromising their aesthetic allure.



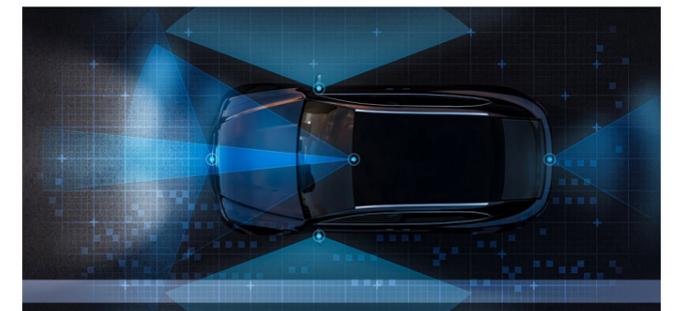
BLACK IS THE MOST UNSAFE COLOR

Black and other dark-colored vehicles create a major obstacle for LiDAR and Computer Vision (camera) in ADAS (Advanced Driver Assistance Systems) for autonomous driving. With automotive black paint reflecting less than 2% of light, it severely limits LiDAR sensors ability to detect vehicles at the critical distance of 200 meters.

BLACK LESS THAN

2%

LIDAR REFLECTIVITY



Sources: Road Safety Commission Vehicle Safety, Government of Western Australia

BLACK METALLIC +9% RHEOLIGHT

ADAS DATA IMPROVEMENTS

LiDAR +280%

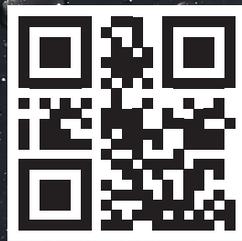
Computer Vision +150%

VISIBILITY LABEL



RheoLighttm

Crystal Glass Pigments



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MOBILITY SPECIAL

CRYSTAL GLASS PIGMENTS FOR
A BRILLIANT, BEAUTIFUL AND
SAFER WORLD



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