COMPANION GLOSSARY

Scientific Terms Explained

A plain-language guide to the terminology in the GoldLeaf GL-1 Technical Dossier and White Paper

Materials & Chemistry

Metal-Organic Framework (MOF)

A crystalline material built from metal ions connected by organic molecules, creating a highly porous three-dimensional structure. MOFs have enormous internal surface area — a single gram can have the surface area of a football pitch. This porosity allows them to adsorb gas molecules efficiently. GL-1 uses a titanium-based MOF that combines gas adsorption with photocatalytic activity.

Photocatalyst

A substance that speeds up a chemical reaction when exposed to light, without being consumed in the process. Like a biological enzyme, a photocatalyst participates in the reaction but regenerates to its original state afterward. GL-1 is a photocatalyst that uses visible light to convert CO2 and water into nitrogen compounds.

Titanium-Nitrogen Coordination Complex

The active component of GL-1. A titanium atom bonded to nitrogen-containing organic molecules (ligands) in a specific three-dimensional arrangement. The titanium centre absorbs light energy and uses it to activate CO2 molecules. The nitrogen ligands position the titanium correctly and participate in the electron transfer that drives the reaction.

Ligand

An organic molecule that bonds to a metal atom in a coordination complex. In GL-1, the nitrogen-containing ligands determine the MOF's crystal structure, pore size, and catalytic properties. Changing the ligand changes the material's behaviour — GoldLeaf's proprietary synthesis route uses specific ligands optimised for atmospheric CO2 capture at ambient conditions.

Polymer Carrier Matrix

The material in which GL-1 particles are dispersed for application to surfaces. Think of it as the vehicle that delivers GL-1 to where it needs to be. The carrier must keep GL-1 particles evenly distributed, maintain their exposure to air and light, and be compatible with the host material (paint, concrete, brick glaze). The carrier composition is protected by a provisional patent.

Coordination Geometry

The three-dimensional arrangement of ligands around a metal atom. In GL-1, the titanium atom's coordination geometry determines how efficiently it absorbs light and transfers electrons to CO2 molecules. Small changes in geometry can dramatically affect catalytic performance — this is why the specific synthesis conditions are trade secrets.

Carbon Capture & Photocatalysis

Photocatalytic CO2 Reduction

The process of using light energy to convert carbon dioxide into useful chemical products. In GL-1, visible light provides the energy to break the stable C=O bonds in CO2 and rearrange the atoms into glycine and urea. This mimics what chlorophyll does in photosynthesis, but using a synthetic compound on a building surface instead of a living plant.

Photoreduction

A chemical reduction (gain of electrons) driven by light energy. In GL-1's mechanism, the titanium centre absorbs a photon, which excites an electron to a higher energy state. This excited electron is transferred to an adsorbed CO2 molecule, reducing it. The titanium then returns to its ground state by accepting an electron from water — completing the catalytic cycle.

Direct Air Capture (DAC)

An industrial process that extracts CO2 directly from ambient air using chemical sorbents or solvents, then concentrates it for storage or use. Companies like Climeworks and Carbon Engineering operate DAC plants. DAC requires significant energy input (2–3 MWh per tonne of CO2) and purpose-built facilities. GL-1 achieves a similar outcome — removing CO2 from air — but passively and at distributed scale.

Carbon Sink

Any system that absorbs more CO2 than it releases. Forests, oceans, and soil are natural carbon sinks. A building surface coated with GL-1 becomes an artificial carbon sink — it continuously removes CO2 from the atmosphere and converts it to soil-enriching compounds.

Carbon Credit

A tradeable certificate representing one tonne of CO2 removed from or prevented from entering the atmosphere. Companies purchase carbon credits to offset their emissions. If GL-1's carbon capture can be independently measured and verified, coated surfaces could generate carbon credits — the Province of Gelderland independently suggested this monetisation pathway.

Biogenic Carbon Cycle

The natural cycle in which CO2 is absorbed by living organisms (plants, bacteria) during growth and released when they decompose. GL-1 creates an analogous synthetic cycle: CO2 is captured on surfaces and converted to nitrogen compounds that enter the soil ecosystem, where they are eventually metabolised by organisms, releasing CO2. The net effect depends on how long the nitrogen compounds persist in soil before full mineralisation.

By-Products & Soil Science

Glycine (Aminoacetic Acid)

The simplest amino acid, with the formula H2N-CH2-COOH. One of the two nitrogen compounds produced when GL-1 catalyses CO2 conversion. Glycine is water-soluble, non-toxic, and readily absorbed by soil microorganisms and plant roots. It occurs naturally in soil and is used commercially as a plant growth enhancer.

Urea

A nitrogen compound with the formula CO(NH2)2. The other product of GL-1's catalytic reaction. Urea is the world's most widely used nitrogen fertiliser. In the concentrations produced by GL-1 (micrograms per square metre per rain event), the quantities are far below agricultural application rates — a micro-fertilisation rather than a fertilisation effect.

Nitrogen Loading

The total amount of nitrogen compounds entering a water body from all sources. Excess nitrogen causes eutrophication (algal blooms, oxygen depletion, fish kills). In the Netherlands, nitrogen regulation is politically highly sensitive (the stikstofcrisis). GL-1's nitrogen by-products, while individually small per square metre, could become significant if deployed across large urban surface areas with drainage to sensitive waterways.

Micro-fertilisation

The delivery of plant nutrients in very small quantities over extended periods. GL-1's nitrogen by-products (glycine, urea) are transported by rainfall to surrounding soil at concentrations far below standard fertiliser application rates. The effect is analogous to a very slow, very dilute fertigation system.

Regulatory & Environmental

CSRD (Corporate Sustainability Reporting Directive)

EU directive requiring large companies to report on sustainability metrics including Scope 1–3 emissions. Creates demand for measurable, verifiable carbon reduction solutions. GL-1's quantifiable absorption rate (200g/m²/year) fits CSRD reporting requirements — companies can calculate the exact carbon reduction from coated surface area.

CBAM (Carbon Border Adjustment Mechanism)

EU mechanism that applies a carbon price to imports of carbon-intensive goods. By increasing the cost of carbon-intensive building materials, CBAM improves the competitive position of GL-1-enhanced products manufactured in Europe.

REACH Registration

EU chemical safety regulation requiring manufacturers to register substances above 1 tonne/year with the European Chemicals Agency (ECHA). GL-1, as a novel chemical substance, requires full REACH registration before commercial sale. This involves toxicological, ecotoxicological, and environmental fate testing — typically 12–24 months and €50K–200K.

EIA (Environmental Impact Assessment)

An assessment required by Dutch law (Wet milieubeheer) before operating a manufacturing facility. Covers emissions, waste, noise, and safety. GoldLeaf's Emmen prototype facility requires an EIA, which has not yet been started. Typical timeline: 12–18 months.

Scope 3 Emissions

Indirect greenhouse gas emissions in a company's value chain — from purchased materials, transport, product use, and end-of-life. Typically the largest share of a company's carbon footprint. GL-1-enhanced building materials allow purchasers to demonstrate Scope 3 reduction in their CSRD reporting.

Stikstofcrisis (Dutch Nitrogen Crisis)

The political and legal crisis triggered by a 2019 Dutch court ruling that the government's nitrogen policy violated EU nature protection law. Construction projects across the Netherlands were halted. Any product that adds nitrogen compounds to the environment — even in small quantities — faces heightened regulatory scrutiny. GL-1's nitrogen by-products must be assessed in this context.

Manufacturing & Process

MOF Synthesis

The chemical process of assembling metal ions and organic ligands into a crystalline MOF structure. Different synthesis conditions (temperature, solvent, reaction time, precursor concentrations) produce MOFs with different properties. GoldLeaf's proprietary synthesis route is what makes GL-1 commercially viable — the general chemistry is published, but the specific conditions for producing a performant, affordable catalyst are trade secrets.

Polymer Compounding

The process of mixing GL-1 powder into the polymer carrier matrix to produce a uniform dispersion that can be added to paints, concrete, or other host materials. Compounding must achieve even particle distribution, maintain GL-1 surface exposure (so it can contact air and light), and be compatible with standard manufacturing equipment.

Accelerated Aging

A laboratory test protocol that subjects materials to intensified environmental conditions (UV light, heat, moisture cycling, freeze-thaw) to simulate years of real-world exposure in a shorter time. GoldLeaf's 18-month accelerated aging protocol is designed to approximate 5 years of outdoor exposure in Northern European conditions. Accelerated aging tests are indicative, not definitive — real-world validation is always needed.

Scale-Up

The process of increasing production from laboratory quantities (grams) to commercial quantities (tonnes). In chemistry, reactions that work at small scale frequently fail at large scale because heat transfer, mixing, and reaction kinetics change with volume. GoldLeaf's prototype facility in Emmen is the first step in validating that GL-1 synthesis scales.