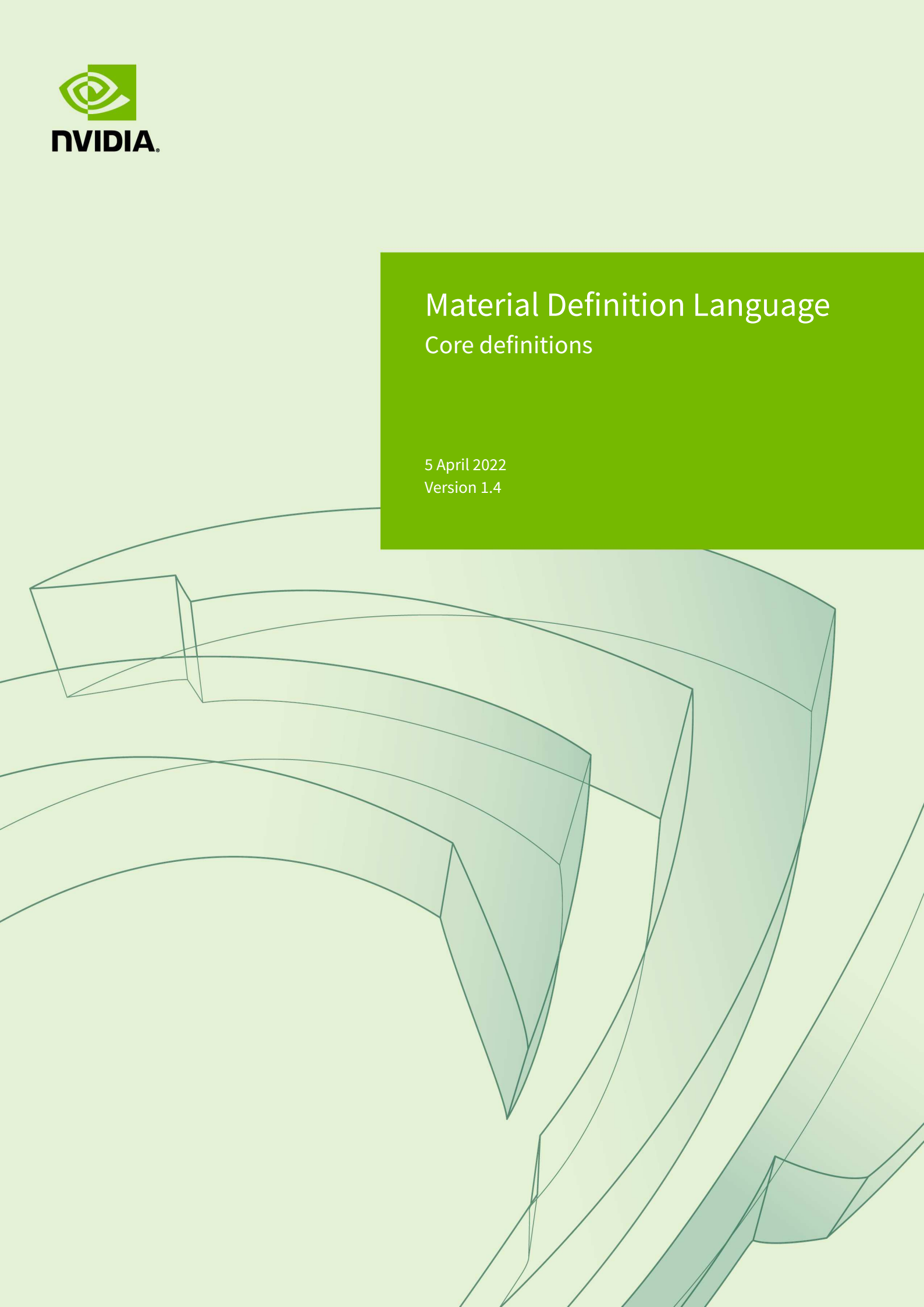


Material Definition Language

Core definitions

5 April 2022
Version 1.4

Material Definition Language – Core definitions

Document build number 349500.8766

Contents

1 Introduction

The Material Definition Language (MDL) module `nvidia::core_definitions` contains a collection of MDL materials. These materials can be used either independently ("simple materials") or in combination with other materials through the use of material combiners and modifiers. Texturing functions provide further control and refinement of material parameter values. Together, materials, combiners, modifiers and the texturing functions can simulate complex, real-world models of appearance.

The core definition materials are listed in "Materials and building blocks" (page 3). The materials are divided into three groups:

Simple materials (page 3)
: Simple materials are used either individually to model visual appareance or as components when creating more complex materials with material combiners and material modifiers.

Modifier materials (page 13)
: Modifier materials are used to create new materials based on already existing materials. They either combine multiple materials into a new material or add additional features to an existing one.

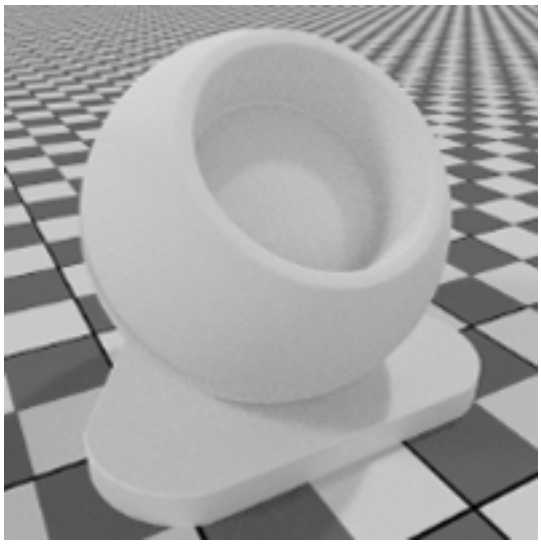
Emissive materials (page 28)
: Emissive materials create light sources from objects by defining how light is emitted from an object's surface.

The functions and enumerations ("enums") used by the core materials are described in "Texturing functions" (page 31) and "Enumerations" (page 45), respectively. For materials and functions, two tables describe their parameters. The first lists the "display names" used by applications for each parameter and a description of that parameter's role in the material or function. The second table lists the display name along with that parameter's data type, identifier, and default value. The tables in "Enumerations" (page 45) list the field names and their meaning.

2 Materials and building blocks

2.1 Simple materials

2.1.1 Simple diffuse



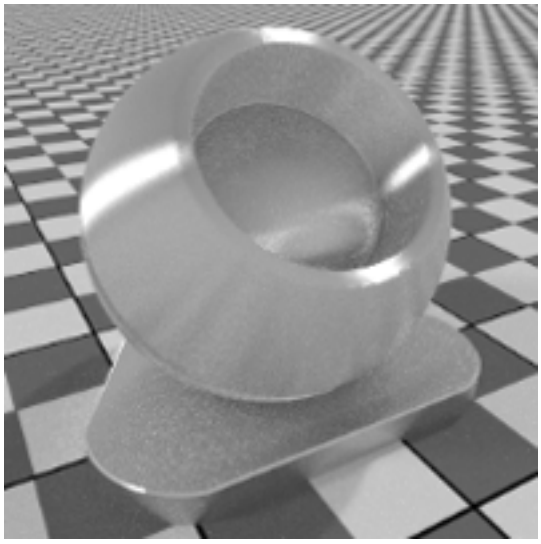
MDL identifier: `core_definitions::diffuse`

A basic diffuse material

Display name	*Description*
Color	The color of the material
Diffuse roughness	Higher roughness values lead a powdery appearance
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Color	`color`	`diffuse_color`	`color(0.8)`
Diffuse roughness	`float`	`roughness`	`0.0`
Bumps	`float3`	`normal`	`state::normal()`

2.1.2 Metal



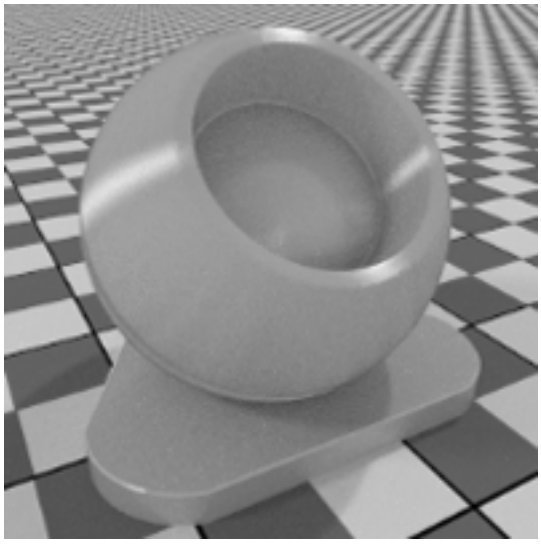
MDL identifier: `core_definitions::scratched_metal_v2`

A metallic material with stretched reflections

Display name	*Description*
Color	The color of the metal
Roughness	Higher roughness values lead to bigger highlights and blurry reflections
Reflection weight	Intensity of highlights and glossy reflections and highlights
Anisotropy	Higher values will stretch the highlight
Anisotropy rotation	Changes the orientation of the anisotropy. A value of 1 will rotate the orientation 360 degrees.
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Color	`color`	`metal_color`	`color(0.9)`
Roughness	`float`	`roughness`	`0.2`
Reflection weight	`float`	`glossy_weight`	`0.9`
Anisotropy	`float`	`anisotropy`	`0.0`
Anisotropy rotation	`float`	`anisotropy_rotation`	`0.0`
Bumps	`float3`	`normal`	`state::normal()`

2.1.3 Plastic



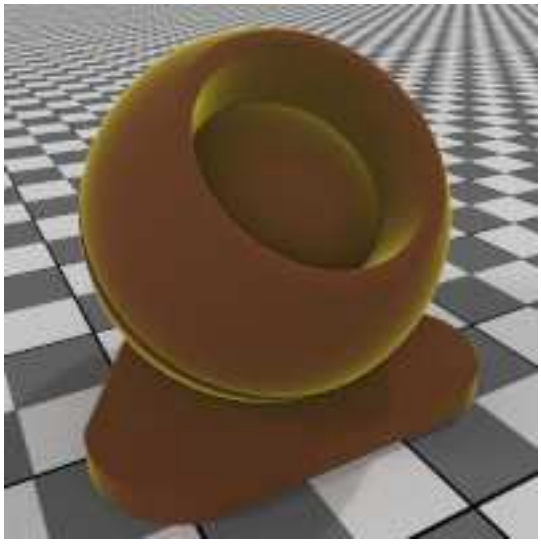
MDL identifier: `core_definitions::scratched_plastic_v2`

A basic dielectric, works for everything opaque that is not metallic. Supports stretched highlights.

Display name	*Description*
Color	The color of the material
Roughness	Higher roughness values lead to bigger highlights and blurry reflections
Anisotropy	Higher values will stretch the highlight
Anisotropy rotation	Changes the orientation of the anisotropy. A value of 1 will rotate the orientation 360 degrees.
IOR	Determines reflectivity
Reflection weight	Additional reflectivity control
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Color	`color`	`diffuse_color`	`color(0.5)`
Roughness	`float`	`roughness`	`0.2`
Anisotropy	`float`	`anisotropy`	`0.0`
Anisotropy rotation	`float`	`anisotropy_rotation`	`0.0`
IOR	`uniform float`	`ior`	`1.4`
Reflection weight	`float`	`reflectivity`	`1.0`
Bumps	`float3`	`normal`	`state::normal()`

2.1.4 Retroreflective



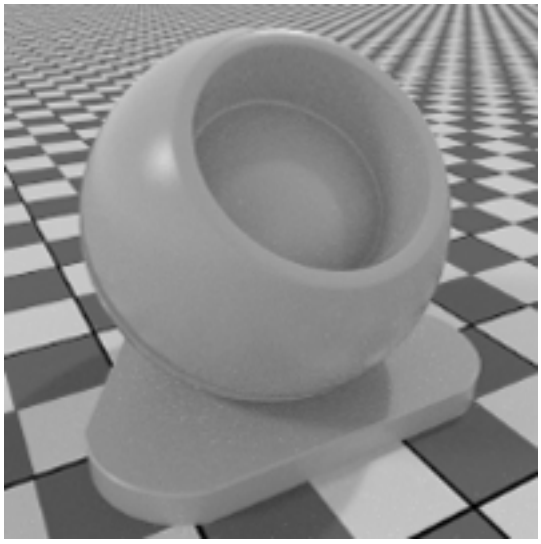
MDL identifier: `core_definitions::retroreflective`

A material with a retroreflective component, works well for road signs and retroreflective stickers

Display name	*Description*
Color	The color of the material
Reflection color	The color of the retroreflection
Roughness	Higher roughness values lead to bigger highlights and blurry reflections
Reflection weight facing	Reflectivity control for geometry facing the viewer
Reflection weight edge	Reflectivity control for the reflectivity at geometry edges
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Color	`color`	`base_color`	`color(0.2,0.23,0.23)`
Reflection color	`color`	`reflection_color`	`color(0.8,0.8,0.83)`
Roughness	`float`	`roughness`	`0.15`
Reflection weight facing	`float`	`normal_reflectivity`	`0.05`
Reflection weight edge	`float`	`grazing_reflectivity`	`1.0`
Bumps	`float3`	`normal`	`state::normal()`

2.1.5 Flexible material model



MDL identifier: `core_definitions::flex_material_v2`

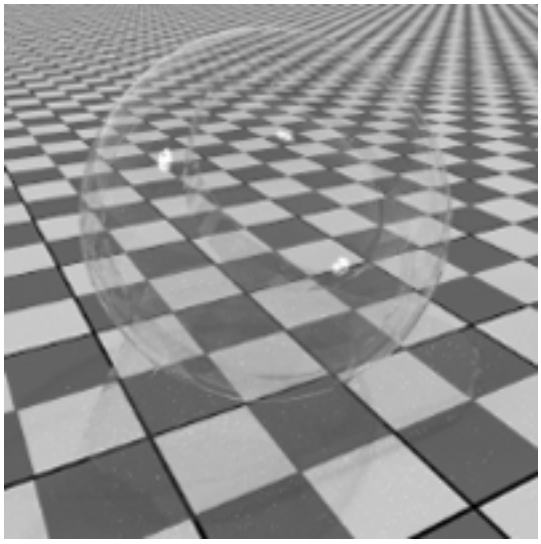
A complex material that can be configured to a wide variety of looks

Display name	*Description*
Base color	The color of the material
Diffuse roughness	Higher roughness values lead to a more “powdery” look
Metallic material	If 1.0, reflection will be colored and independent of view direction. If 0.0, reflection will be white and direction dependent. Directional dependence is in this case based on the IOR (Fresnel effect).
Reflection weight	Controls the amount of reflection
Reflection roughness	Higher roughness values lead to more blurry reflections
Reflection anisotropy	Higher values will stretch the highlight
Anisotropy rotation	Changes the orientation of the anisotropy. A value of 1 will rotate the orientation 360 degrees.
Transmission weight	Weights how much light passes through the object compared to its diffuse reflectivity.
Transmission color	Color effect for transmission independent of thickness of the object, similar to stained glass.
Volume color	If the material is not “Thin walled”, “Volume color” will be reached at “Volume reference distance” (m).
Transmission roughness	higher values lead to objects seen through the material to appear blurry
Volume reference distance	If the material is not “Thin walled”, “Volume color” will be reached at this distance (m). Enter a typical thickness of objects made of this material here.
IOR	Determines refraction in the volume. It also influences the reflectivity for materials that are not metallic.
Thin walled	Thin walled materials do not refract and do not have volume effects. Good for soap bubbles or window glass.

Bumps	Attach bump or normal maps here
Abbe number	Controls dispersion. A value of 0 switches dispersion off. Dispersive materials have Abbe numbers between 25 and 85

Display name	*Type*	*Parameter*	*Default*
Base color	`color`	`base_color`	`color(0.5)`
Diffuse roughness	`float`	`diffuse_roughness`	`0.0`
Metallic material	`float`	`is_metal`	`0.0`
Reflection weight	`float`	`reflectivity`	`1.0`
Reflection roughness	`float`	`reflection_roughness`	`0.3`
Reflection anisotropy	`float`	`anisotropy`	`0.0`
Anisotropy rotation	`float`	`anisotropy_rotation`	`0.0`
Transmission weight	`float`	`transparency`	`0.0`
Transmission color	`color`	`transmission_color`	`color(1.0)`
Volume color	`uniform color`	`volume_color`	`color(1.0)`
Transmission roughness	`float`	`transmission_roughness`	`0.0`
Volume reference distance	`uniform float`	`base_thickness`	`0.1`
IOR	`uniform float`	`ior`	`1.5`
Thin walled	`uniform bool`	`thin_walled`	`false`
Bumps	`float3`	`normal`	`state::normal()`
Abbe number	`uniform float`	`abbe_number`	`0.0`

2.1.6 Thin glass



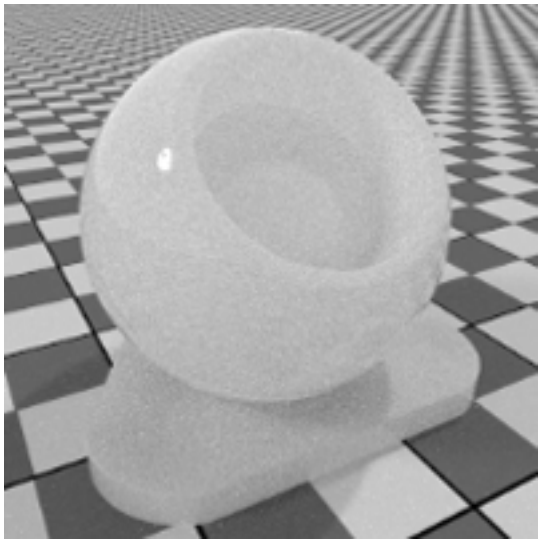
MDL identifier: `core_definitions::thin_glass_v2`

A basic transmissive dielectric without refraction or volume

Display name	*Description*
Transmission color	The color of the material
Roughness	Higher roughness values lead to bigger highlights and blurry reflections
IOR	Determines reflectivity
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Transmission color	`color`	`glass_color`	`color(0.95)`
Roughness	`float`	`roughness`	`0.0`
IOR	`uniform float`	`ior`	`1.4`
Bumps	`float3`	`normal`	`state::normal()`

2.1.7 Thin translucent



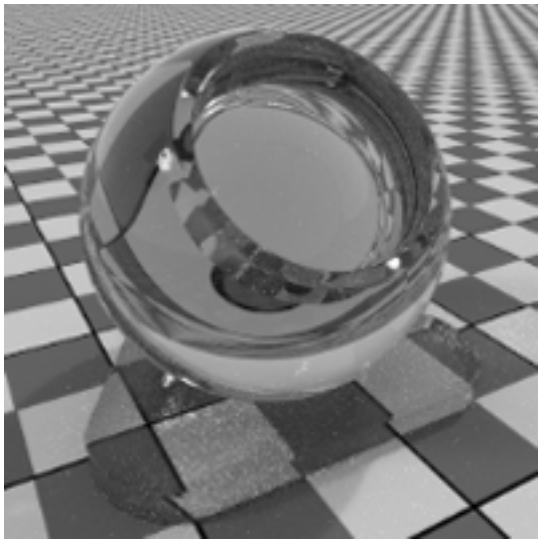
MDL identifier: `core_definitions::thin_translucent_v2`

A diffuse transmissive dielectric material

Display name	*Description*
Diffuse color	The color of the material
Translucence color	The color of the volume of the material
Translucence weight	Fraction of the incoming light that should be visible on the backside
Roughness	Higher roughness values lead to bigger highlights and blurry reflections
IOR	Determines reflectivity
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Diffuse color	`color`	`surface_color`	`color(0.95)`
Translucence color	`color`	`translucent_color`	`color(0.95)`
Translucence weight	`float`	`translucency`	`0.5`
Roughness	`float`	`roughness`	`0.0`
IOR	`uniform float`	`ior`	`1.4`
Bumps	`float3`	`normal`	`state::normal()`

2.1.8 Thick glass



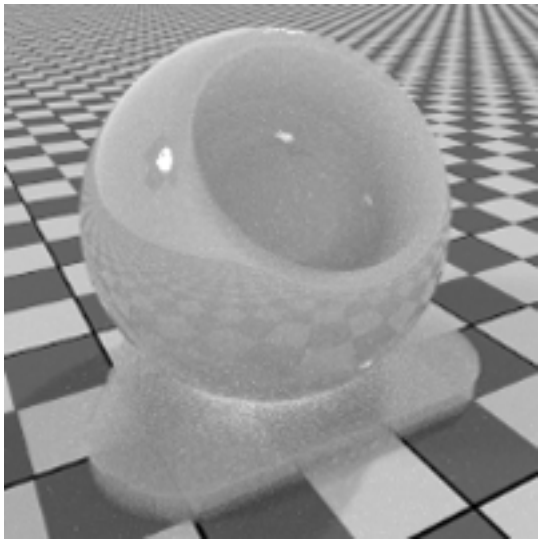
MDL identifier: `core_definitions::thick_glass_v2`

A basic transmissive dielectric with refraction and coloring in the volume

Display name	*Description*
Transmission color	Colors the light entering the volume, similar to stained glass
Volume color	The color of the glass body
Roughness	Higher roughness values lead to bigger highlights and blurry reflections
IOR	Determines reflectivity as well as amount of refraction
Volume reference distance	"Volume color" will be reached at this distance (m). Enter a typical thickness of objects made of this material here.
Bumps	Attach bump or normal maps here
Abbe number	Controls dispersion. 0 switches dispersion off. Dispersive materials have Abbe numbers between 25 and 85.

Display name	*Type*	*Parameter*	*Default*
Transmission color	`color`	`transmission_color`	`color(1.0)`
Volume color	`uniform color`	`glass_color`	`color(0.95)`
Roughness	`float`	`roughness`	`0.0`
IOR	`uniform float`	`ior`	`1.4`
Volume reference distance	`uniform float`	`base_thickness`	`0.1`
Bumps	`float3`	`normal`	`state::normal()`
Abbe number	`uniform float`	`abbe_number`	`0.0`

2.1.9 Thick translucent



MDL identifier: `core_definitions::thick_translucent_v2`

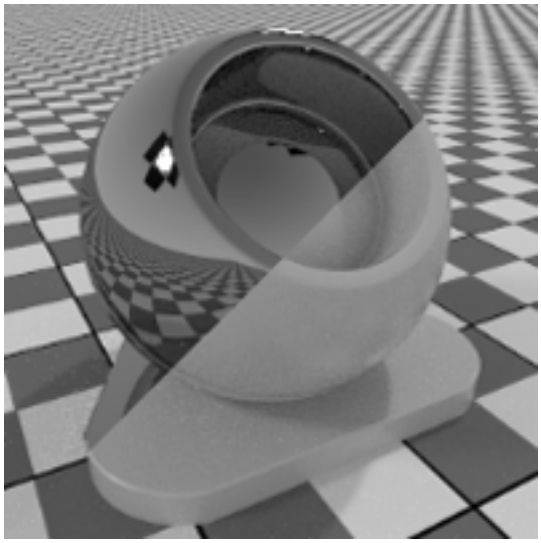
A subsurface scattering material

Display name	*Description*
Transmission color	The color of the material
Volume color	The color of the volume at “Volume reference distance”
Volume scattering	Amount of scattering for objects at “Volume reference distance”
Reflection roughness	Higher roughness values lead to bigger highlights and blurry reflections
Reflection weight	Overall reflectivity of the material
Volume reference distance	“Volume color” and “Volume scattering” will be reached at this distance (m). Enter a typical thickness of objects made of this material here.
Bumps	Attach bump or normal maps here
IOR	Determines reflectivity as well as amount of refraction
Abbe number	Controls dispersion. A value of 0 switches dispersion off, Dispersive materials have Abbe numbers between 25 and 85.

Display name	*Type*	*Parameter*	*Default*
Transmission color	`color`	`transmission_color`	`color(0.95)`
Volume color	`uniform color`	`volume_color`	`color(0.95)`
Volume scattering	`uniform float`	`volume_scattering`	`0.5`
Reflection roughness	`float`	`roughness`	`0.0`
Reflection weight	`float`	`reflectivity`	`1.0`
Volume reference distance	`uniform float`	`base_thickness`	`0.1`
Bumps	`float3`	`normal`	`state::normal()`
IOR	`uniform float`	`ior`	`1.4`
Abbe number	`uniform float`	`abbe_number`	`0.0`

2.2 Modifier materials

2.2.1 Surface blender



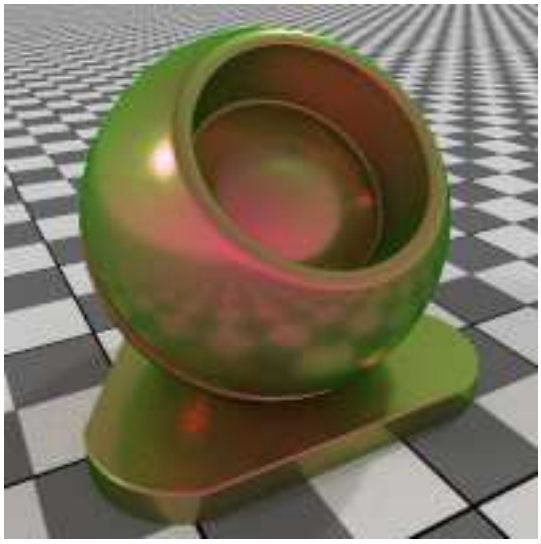
MDL identifier: `core_definitions::blend`

Blend surface characteristics of 2 materials or mask them using a texture

Display name	*Description*
Base material	The material the blend is based on
Blend Material	Surface properties to use for the blend
Blend weight	Blend weight or mask texture

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`scratched_plastic_v2()`
Blend Material	`material`	`blend`	`scratched_metal_v2()`
Blend weight	`float`	`weight`	`0.0`

2.2.2 Surface falloff



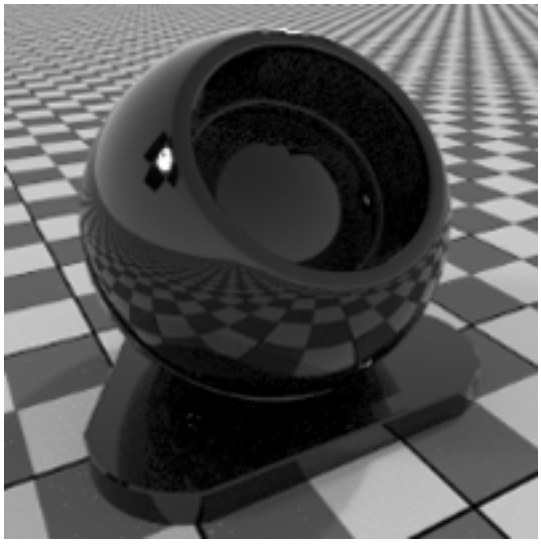
MDL identifier: `core_definitions::surface_falloff`

Blend surface characteristics of 2 materials or mask them using a texture

Display name	*Description*
Base material	The material the blend is based on
Blend Material	Surface properties to use for the blend
Blend weight facing	Blend weight or mask texture
Blend weight edge	Blend weight or mask texture
Blend bias	Controls how fast the transition should happen. 5.0 results in fresnel like transition.

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`scratched_plastic_v2()`
Blend Material	`material`	`blend`	`scratched_metal_v2()`
Blend weight facing	`float`	`facing_weight`	`0.0`
Blend weight edge	`float`	`edge_weight`	`1.0`
Blend bias	`float`	`blend_bias`	`1.0`

2.2.3 Apply clear coating



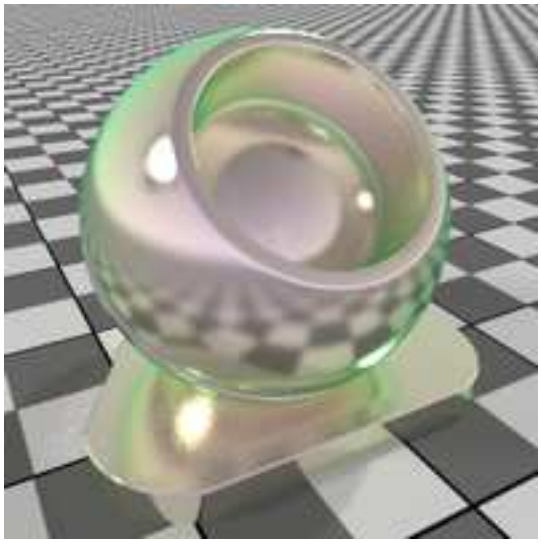
MDL identifier: `core_definitions::apply_clearcoat_v2`

Apply clear coat to an existing material

Display name	*Description*
Base material	The material that will get a clear coating applied
IOR	Determines reflectivity of the clear coat
Reflection roughness	Determines roughness of the clear coat
Coat visibility	Determines visibility of the clear coat
Bumps	Attach bump or normal maps here
Coat filter color	For simulating coatings with colored resins that modulate the color of underlying layers

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`diffuse(diffuse_color: color(0.0))`
IOR	`uniform float`	`ior`	`1.6`
Reflection roughness	`float`	`roughness`	`0.0`
Coat visibility	`float`	`visibility`	`1.0`
Bumps	`float3`	`normal`	`state::normal()`
Coat filter color	`color`	`coat_filter_color`	`color(1.0)`

2.2.4 Apply thin film



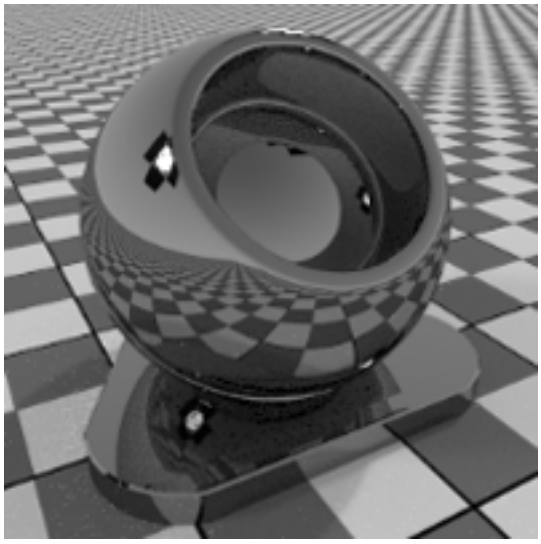
MDL identifier: `core_definitions::apply_thinfilm`

Apply thin film to an existing material

Display name	*Description*
Base material	The material that will get shows a thin film effect
IOR	The IOR of the thin film interface
Thickness	Thickness of the thin film in nm

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`scratched_metal_v2()`
IOR	`uniform float`	`ior`	`1.6`
Thickness	`float`	`thickness`	`400.0`

2.2.5 Apply thin metal coating



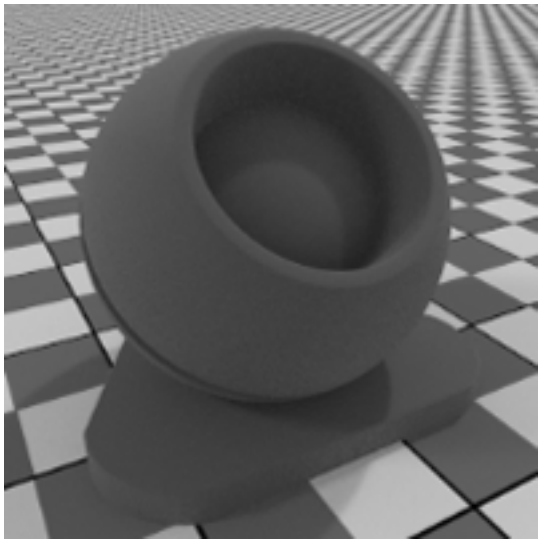
MDL identifier: `core_definitions::apply_metalcoat_v2`

Apply metal coat to an existing material

Display name	*Description*
Base material	The material that will get a metallic coating applied
Reflection color	The color of the metal
Reflection weight	The opacity of the coat
Reflection roughness	Determines roughness of the metal coat
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`diffuse(diffuse_color: color(0.0))`
Reflection color	`color`	`metal_color`	`color(0.95)`
Reflection weight	`float`	`visibility`	`0.3`
Reflection roughness	`float`	`roughness`	`0.0`
Bumps	`float3`	`normal`	`state::normal()`

2.2.6 Apply a cover of dust



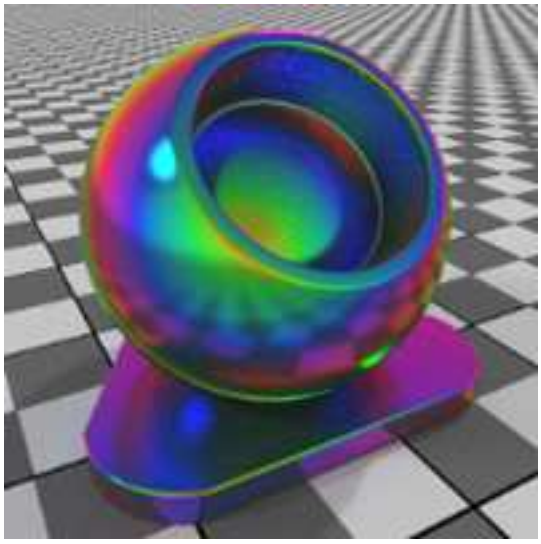
MDL identifier: `core_definitions::apply_dustcover`

Apply a diffuse cover of dust or dirt

Display name	*Description*
Base material	The material that will get a clear coating applied
Dust color	The color of the dust
Dust density	The opacity of the cover
Dust amount	How dusty the material is
Bumps	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`diffuse(diffuse_color: color(0.0))`
Dust color	`color`	`dust_color`	`color(0.7)`
Dust density	`float`	`visibility`	`1.0`
Dust amount	`uniform float`	`dust_density`	`0.5`
Bumps	`float3`	`normal`	`state::normal()`

2.2.7 Apply a color falloff



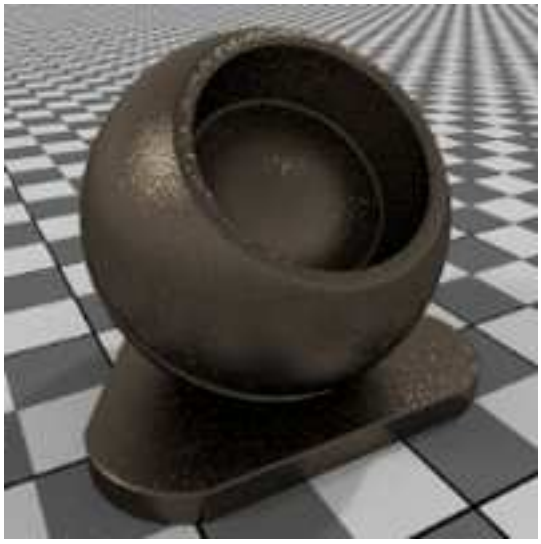
MDL identifier: `core_definitions::apply_colorfalloff_v2`

Makes the color view dependent

Display name	*Description*
Base material	The material that will get a clear coating applied
Color 1	Color 1 (facing direction)
Color 2	Color 2
Color 3	Color 3
Color 4	Color 4
Color 5	Color 5 (object edges)

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`scratched_metal_v2(metal_color: color(1.0))`
Color 1	`uniform color`	`color_0`	`color(1.0, 1.0, 1.0)`
Color 2	`uniform color`	`color_1`	`color(0.0, 0.0, 0.0)`
Color 3	`uniform color`	`color_2`	`color(0.0, 0.0, 0.0)`
Color 4	`uniform color`	`color_3`	`color(1.0, 1.0, 1.0)`
Color 5	`uniform color`	`color_4`	`color(0.0, 0.0, 0.0)`

2.2.8 Apply flake coating



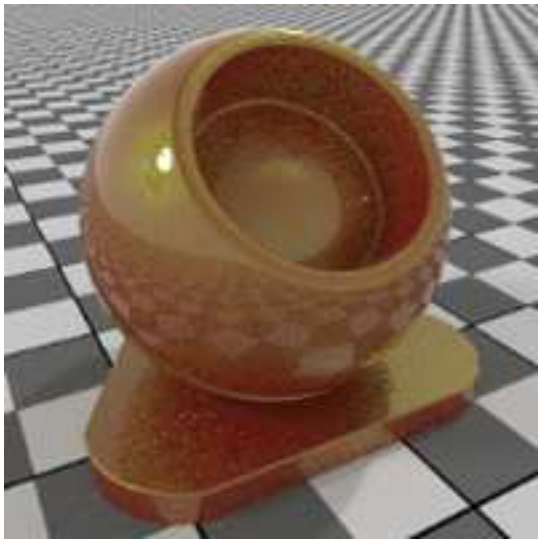
MDL identifier: `core_definitions::apply_metallicflakes`

Apply layer of metallic flakes to an existing material

Display name	*Description*
Base material	The material that will get a flake layer applied
Color	The color of the flakes
Roughness	Determines roughness of the metallic flakes
Flake size	Determines size of the metallic flakes, in mm
Flake amount	Determines amount of visible metallic flakes
Flake opacity	Determines visibility of the metallic flakes
Flake orientation randomness	Larger numbers will increase the sparkle radius around highlights

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`diffuse(diffuse_color: color(0.0))`
Color	`color`	`flake_color`	`color(0.9,0.9,0.9)`
Roughness	`float`	`roughness`	`0.0`
Flake size	`uniform float`	`size`	`1.0`
Flake amount	`uniform float`	`amount`	`0.5`
Flake opacity	`uniform float`	`opacity`	`0.5`
Flake orientation randomness	`uniform float`	`bump`	`1.0`

2.2.9 Flaky paint



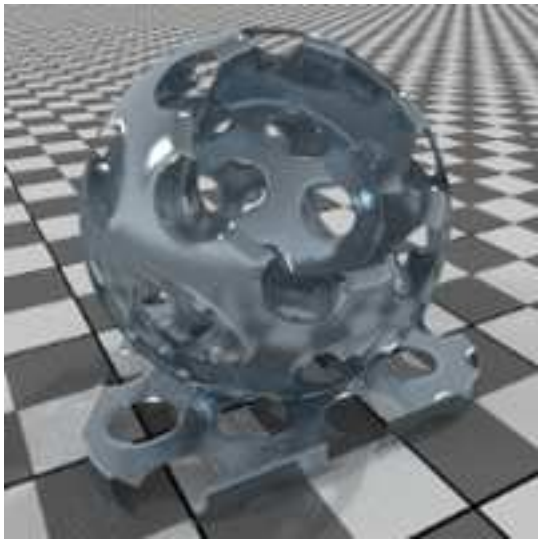
MDL identifier: `core_definitions::flake_paint`

A multi layer paint material containing flakes

Display name	*Description*
Base color	The color of the base paint
Flake color	The color of the flakes
Flake roughness	Determines roughness of the metallic flakes
Flake size	Determines size of the metallic flakes, in mm
Flake amount	Determines amount of visible metallic flakes
Flake weight	Determines visibility of the metallic flakes
Flake orientation randomness	Larger numbers will increase the sparkle radius around highlights
IOR	Determines reflectivity of the clear coat
Coat roughness	Determines roughness of the clear coat
Coat bump	Attach bump or normal maps here

Display name	*Type*	*Parameter*	*Default*
Base color	`color`	`base_color`	`color(0.3,0.31,0.31)`
Flake color	`color`	`flake_color`	`color(0.6,1,0.6)`
Flake roughness	`float`	`roughness`	`0.15`
Flake size	`uniform float`	`size`	`1.0`
Flake amount	`uniform float`	`amount`	`0.4`
Flake weight	`uniform float`	`opacity`	`0.8`
Flake orientation randomness	`uniform float`	`bump`	`1.0`
IOR	`uniform float`	`ior`	`1.6`
Coat roughness	`float`	`coat_roughness`	`0.0`
Coat bump	`float3`	`coat_bump`	`state::normal()`

2.2.10 Add cut-outs



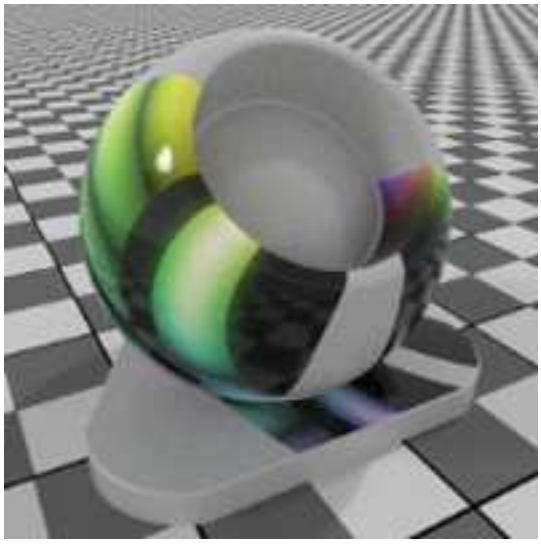
MDL identifier: `core_definitions::add_cutout`

Adds cut-outs to existing materials. Also forces material to be thin-walled. Good for modeling leaves, grass or fences.

Display name	*Description*
Base material	The material that will get a cut-out
Cutout	Determines where the object is visible

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`scratched_plastic_v2()`
Cutout	`float`	`cutout`	`1.0`

2.2.11 Add simple sticker



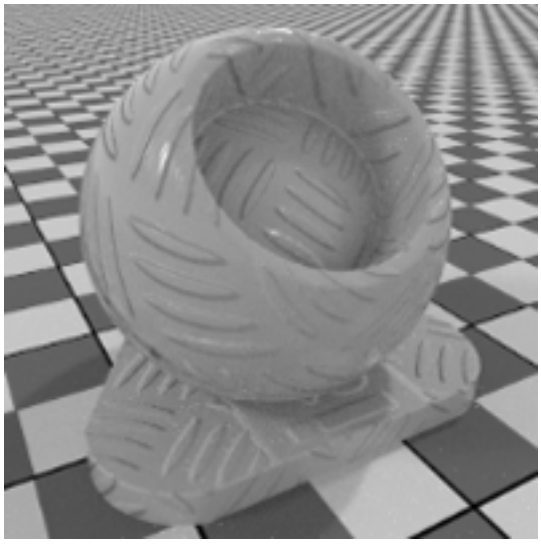
MDL identifier: `core_definitions::add_simple_sticker`

A quick way for adding simple stickers to a material. The sticker is a simple dielectric and needs a mask to define its extent.

Display name	*Description*
Sticker color	The color of the material
Sticker roughness	Higher roughness values lead to bigger highlights and blurry reflections
Sticker IOR	Determines reflectivity
Sticker reflectivity	Additional Reflectivity control
Sticker bumps	Attach bump or normal maps here
Sticker mask	Determines extent of the sticker
Base material	The material that will get a sticker added

Display name	*Type*	*Parameter*	*Default*
Sticker color	`color`	`diffuse_color`	`color(0.5)`
Sticker roughness	`float`	`roughness`	`0.05`
Sticker IOR	`uniform float`	`ior`	`1.4`
Sticker reflectivity	`float`	`reflectivity`	`1.0`
Sticker bumps	`float3`	`sticker_normal`	`state::normal()`
Sticker mask	`float`	`sticker_mask`	`0.0`
Base material	`material`	`base`	`scratched_plastic_v2()`

2.2.12 Add global bumpmap



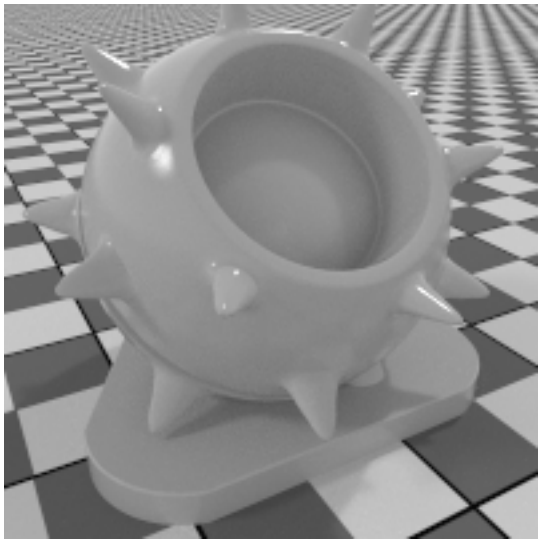
MDL identifier: `core_definitions::add_globalbump`

Adds global bumpmap to existing materials. Local bump map of the base material is preserved.

Display name	*Description*
Base material	The material that will get a bump map
Bump	An additional global bump map for the material. Local bump map of the base material is preserved.

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`scratched_plastic_v2()`
Bump	`float3`	`normal`	`state::normal()`

2.2.13 Add displacement



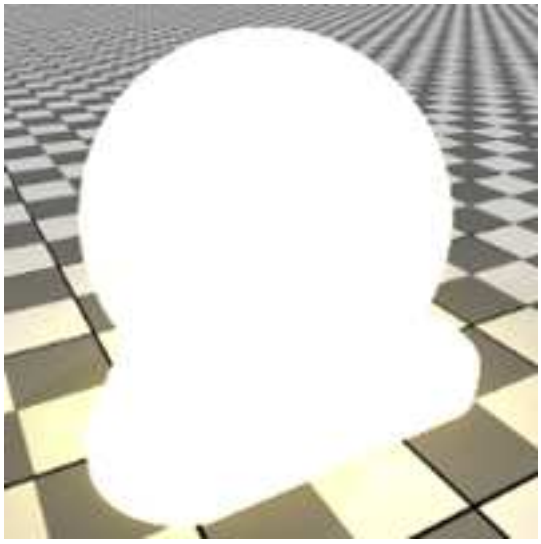
MDL identifier: `core_definitions::add_displacement`

Adds displacement to existing materials

Display name	*Description*
Base material	The material that will get a bump map
Displacement amount	Attach displacement texture here. Note that the object needs to be set up correctly to have good displacement results.
Displacement scale	A global scale factor for the displacement amount

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`scratched_plastic_v2()`
Displacement amount	`float`	`displacement`	`0.0`
Displacement scale	`uniform float`	`displacement_scale`	`1.0`

2.2.14 Add emission



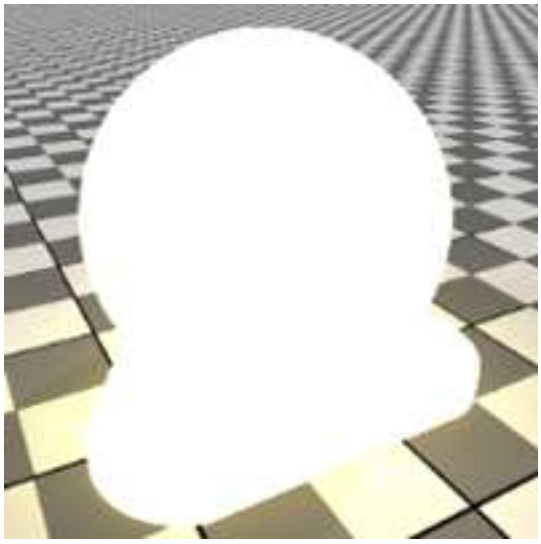
MDL identifier: `core_definitions::add_emission`

Adds emission to a material

Display name	*Description*
Base material	The material that will get emission added
Color	The color of the light
Intensity	The brightness of the light source
Unit scale	Modeling unit to meter conversion factor
Unit for emission	The physical unit of “Intensity”

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`diffuse(diffuse_color: color(0.0))`
Color	`color`	`tint`	`color(1.0)`
Intensity	`uniform float`	`intensity`	`1000`
Unit scale	`uniform float`	`unit_scale`	`1.0`
Unit for emission	`uniform emission_type`	`unit`	`lumen_m2`

2.2.15 Add thermal emission



MDL identifier: `core_definitions::add_thermal_emission`

Adds emission to a material, color is based on a “color temperature”

Display name	*Description*
Base material	The material that will get emission added
Temperature	The color temperature of the light in Kelvin
Intensity	The brightness of the light source
Unit for emission	The physical unit of “Intensity”

Display name	*Type*	*Parameter*	*Default*
Base material	`material`	`base`	`diffuse(diffuse_color: color(0.0))`
Temperature	`uniform float`	`temperature`	`6500.0`
Intensity	`uniform float`	`intensity`	`1000`
Unit for emission	`uniform emission_type`	`unit`	`lumen_m2`

2.3 Emissive materials

2.3.1 Diffuse emission

MDL identifier: `core_definitions::light_omni`

Emissive material emitting in all directions

Display name	*Description*
Color	The color of the light
Intensity	The brightness of the light source
Unit scale	Modeling unit to meter conversion factor
Unit for emission	The physical unit of “Intensity”

Display name	*Type*	*Parameter*	*Default*
Color	`color`	`tint`	`color(1.0)`
Intensity	`uniform float`	`intensity`	`1000`
Unit scale	`uniform float`	`unit_scale`	`1.0`
Unit for emission	`uniform emission_type`	`unit`	`lumen_m2`

2.3.2 Spotlight emission

MDL identifier: `core_definitions::light_spot`

Emissive material emitting focused in one direction

Display name	*Description*
Color	The color of the light
Intensity	The brightness of the light source
Unit scale	Modeling unit to meter conversion factor
Spot focus	larger values lead to more focused spotlights
Unit for emission	The physical unit of “Intensity”

Display name	*Type*	*Parameter*	*Default*
Color	`color`	`tint`	`color(1.0)`
Intensity	`uniform float`	`intensity`	`1000`
Unit scale	`uniform float`	`unit_scale`	`1.0`
Spot focus	`uniform float`	`spot_exponent`	`30`
Unit for emission	`uniform emission_type`	`unit`	`lumen_m2`

2.3.3 IES file based emission

MDL identifier: `core_definitions::light_ies`

Emissive material emitting as described in an IES file

Display name	*Description*
IES light profile data	Data to describe the distribution of the light
Color	The color of the light
Intensity	The brightness of the light source
Unit scale	Modeling unit to meter conversion factor

Display name	*Type*	*Parameter*	*Default*
IES light profile data	`uniform light_profile`	`profile`	
Color	`color`	`tint`	`color(1.0)`
Intensity	`uniform float`	`intensity`	`1`
Unit scale	`uniform float`	`unit_scale`	`1.0`

3 Texturing functions

3.1 Blend colors

MDL identifier: `core_definitions::blend_colors`

Allows combining textures and colors in varied ways

Display name	*Description*
Color 1	
Color 2	
Blend mode	Describes how Color 1 and Color 2 are combined
Blend weight	Defines strength of the effect. At weight 0, only color 1 will be visible. At weight 1, the blend function will have full effect.
Linear blend	The blend opperation can either be applied in linear or gamma (2.2) color space

Display name	*Type*	*Parameter*	*Default*
Color 1	`color`	`color_1`	`color(0.0)`
Color 2	`color`	`color_2`	`color(1.0)`
Blend mode	`uniform color_layer_mode`	`mode`	`color_layer_blend`
Blend weight	`float`	`weight`	`1.0`
Linear blend	`uniform bool`	`linear_blend`	`true`

3.2 Bitmap texture

MDL identifier: `core_definitions::file_texture`

Allows texturing using image files of various file formats

Display name	*Description*
Bitmap file	
Scalar mode	Defines how the texture applies to scalar parameters
Brightness	
Contrast	
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees
Clip	If set to true, texture will not repeat. Outside of the texture, color will be black and the scalar value will be 0.
UV space index	Selects a specific UV space
Invert image	Invert image

Display name	*Type*	*Parameter*	*Default*
Bitmap file	`uniform texture_2d`	`texture`	
Scalar mode	`uniform mono_mode`	`mono_source`	`mono_average`
Brightness	`uniform float`	`brightness`	`1.0`
Contrast	`uniform float`	`contrast`	`1.0`
Tiling	`uniform float2`	`scaling`	`float2(1.0)`
Offset	`uniform float2`	`translation`	`float2(0.0)`
Rotation	`uniform float`	`rotation`	`0.0`
Clip	`uniform bool`	`clip`	`false`
UV space index	`uniform int`	`texture_space`	`0`
Invert image	`uniform bool`	`invert`	`false`

3.3 Perlin noise texture

MDL identifier: `core_definitions::perlin_noise_texture`

Enable texturing with a random noise pattern

Display name	*Description*
Color 1	
Color 2	
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
Levels	Higher amounts will add detail to the noise
Billowing appearance	
Upper threshold	Lowering this value will create bigger areas uniformly colored with Color 1
Lower threshold	Increasing this value will create bigger areas uniformly colored with Color 2
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.

Display name	*Type*	*Parameter*	*Default*
Color 1	`color`	`color1`	`color(1.0)`
Color 2	`color`	`color2`	`color(0.0)`
Use object space	`uniform bool`	`object_space`	`true`
Levels	`uniform int`	`noise_levels`	`3`
Billowing appearance	`uniform bool`	`absolute_noise`	`false`
Upper threshold	`uniform float`	`noise_threshold_high`	`1.0`
Lower threshold	`uniform float`	`noise_threshold_low`	`0.0`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`
UV space index	`uniform int`	`texture_space`	`0`

3.4 Perlin noise texture – bump mapping

MDL identifier: `core_definitions::perlin_noise_bump_texture`

Enable bump-map texturing with a random noise pattern

Display name	*Description*
Bump strength	
Tiling	Controls the scale of the texture on the object
Levels	Higher amounts will add detail to the noise
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
Billowing appearance	
Upper threshold	Lowering this value will create bigger areas uniformly colored with Color 1
Lower threshold	Increasing this value will create bigger areas uniformly colored with Color 2
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.

Display name	*Type*	*Parameter*	*Default*
Bump strength	`uniform float`	`factor`	`1.0`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Levels	`uniform int`	`noise_levels`	`1`
Use object space	`uniform bool`	`object_space`	`true`
Billowing appearance	`uniform bool`	`absolute_noise`	`false`
Upper threshold	`uniform float`	`noise_threshold_high`	`1.0`
Lower threshold	`uniform float`	`noise_threshold_low`	`0.0`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`
UV space index	`uniform int`	`texture_space`	`0`

3.5 Cellular noise texture

MDL identifier: `core_definitions::worley_noise_texture`

Allow texturing with a cell forming pattern

Display name	*Description*
Color 1	
Color 2	
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.
Cell type	Cell pattern type
Cell shape	The shape of the cell form
Upper threshold	Lowering this value will create bigger areas uniformly colored with Color 1
Lower threshold	Increasing this value will create bigger areas uniformly colored with Color 2
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees

Display name	*Type*	*Parameter*	*Default*
Color 1	`color`	`color1`	`color(1.0)`
Color 2	`color`	`color2`	`color(0.0)`
Use object space	`uniform bool`	`object_space`	`true`
UV space index	`uniform int`	`texture_space`	`0`
Cell type	`uniform cell_type`	`mode`	`simple_cells`
Cell shape	`uniform cell_base`	`metric`	`circular_cells`
Upper threshold	`uniform float`	`noise_threshold_high`	`1.0`
Lower threshold	`uniform float`	`noise_threshold_low`	`0.0`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`

3.6 Cellular noise texture – bump mapping

MDL identifier: `core_definitions::worley_noise_bump_texture`

Allow texturing with a cell forming pattern

Display name	*Description*
Bump strength	
Cell shape	The shape of the cell form
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.
Upper threshold	Lowering this value will create bigger areas uniformly colored with Color 1
Lower threshold	Increasing this value will create bigger areas uniformly colored with Color 2
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees

Display name	*Type*	*Parameter*	*Default*
Bump strength	`uniform float`	`factor`	`1.0`
Cell shape	`uniform cell_base`	`metric`	`circular_cells`
Use object space	`uniform bool`	`object_space`	`true`
UV space index	`uniform int`	`texture_space`	`0`
Upper threshold	`uniform float`	`noise_threshold_high`	`1.0`
Lower threshold	`uniform float`	`noise_threshold_low`	`0.0`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`

3.7 Flow noise texture

MDL identifier: `core_definitions::flow_noise_texture`

Allow texturing with a 2D noise pattern suitable for waves

Display name	*Description*
Color 1	
Color 2	
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.
Levels	Higher amounts will add detail to the noise
Billowing appearance	
Phase offset	Controls the third dimension of the function
Level intensity gain	If multiple levels are used, this parameter specifies a weighting factor for subsequent levels
Level scaling	If multiple levels are used, this parameter specifies a global scaling factor for subsequent levels
Progressive u scale	If multiple levels are used, this parameter specifies an additional scaling factor in the “u” direction
Progressive v offset	If multiple levels are used, this parameter specifies an offset for subsequent levels in the “v” direction
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees

Display name	*Type*	*Parameter*	*Default*
Color 1	`color`	`color1`	`color(1.0)`
Color 2	`color`	`color2`	`color(0.0)`
Use object space	`uniform bool`	`object_space`	`false`
UV space index	`uniform int`	`texture_space`	`0`
Levels	`uniform int`	`noise_levels`	`3`
Billowing appearance	`uniform bool`	`absolute_noise`	`false`
Phase offset	`uniform float`	`phase`	`0.0`
Level intensity gain	`uniform float`	`level_gain`	`0.5`
Level scaling	`uniform float`	`level_scale`	`2.0`
Progressive u scale	`uniform float`	`level_progressive_u_scale`	`1.0`
Progressive v offset	`uniform float`	`level_progressive_v_motion`	`0.0`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`

3.8 Flow noise texture – bump mapping

MDL identifier: `core_definitions::flow_noise_bump_texture`

Allow texturing with a 2D noise pattern suitable for waves

Display name	*Description*
Bump strength	
Tiling	Controls the scale of the texture on the object
Levels	Higher amounts will add detail to the noise
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.
Billowing appearance	
Phase offset	Controls the 3rd dimension of the function
Level intensity gain	If multiple levels are used, this parameter specifies a weighting factor for subsequent levels
Level scaling	If multiple levels are used, this parameter specifies a global scaling factor for subsequent levels
Progressive u scale	If multiple levels are used, this parameter specifies an additional scaling factor in the “u” direction
Progressive v offset	If multiple levels are used, this parameter specifies an offset for subsequent levels in the “v” direction
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees

Display name	*Type*	*Parameter*	*Default*
Bump strength	`uniform float`	`factor`	`1.0`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Levels	`uniform int`	`noise_levels`	`1`
Use object space	`uniform bool`	`object_space`	`false`
UV space index	`uniform int`	`texture_space`	`0`
Billowing appearance	`uniform bool`	`absolute_noise`	`false`
Phase offset	`uniform float`	`phase`	`0.0`
Level intensity gain	`uniform float`	`level_gain`	`0.5`
Level scaling	`uniform float`	`level_scale`	`2.0`
Progressive u scale	`uniform float`	`level_progressive_u_scale`	`1.0`
Progressive v offset	`uniform float`	`level_progressive_v_motion`	`0.0`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`

3.9 3D checker texture

MDL identifier: `core_definitions::checker_texture`

Allows texturing a checkerboard pattern

Display name	*Description*
Color 1	
Color 2	
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
Blur	
Rotation	Rotation angle of the texture in degrees
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.

Display name	*Type*	*Parameter*	*Default*
Color 1	`color`	`color1`	`color(1.0)`
Color 2	`color`	`color2`	`color(0.0)`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Use object space	`uniform bool`	`object_space`	`false`
Blur	`uniform float`	`blur`	`0`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`
UV space index	`uniform int`	`texture_space`	`0`

3.10 3D checker texture – bump mapping

MDL identifier: `core_definitions::checker_bump_texture`

Allows texturing a checkerboard pattern

Display name	*Description*
Bump strength	
Blur	
Use object space	If off, UV space will be used. If on, 3D texturing in object space will apply. For applications that do not support object space, world space will be used.
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees
UV space index	Only applies if “Use object space” is off. Selects a specific UV space.

Display name	*Type*	*Parameter*	*Default*
Bump strength	`uniform float`	`factor`	`1.0`
Blur	`uniform float`	`blur`	`0`
Use object space	`uniform bool`	`object_space`	`false`
Tiling	`uniform float3`	`scaling`	`float3(10.0)`
Offset	`uniform float3`	`translation`	`float3(0.0)`
Rotation	`uniform float3`	`rotation`	`float3(0.0)`
UV space index	`uniform int`	`texture_space`	`0`

3.11 Bitmap texture, bump

MDL identifier: `core_definitions::file_bump_texture`

Allows texturing using image files of various file formats

Display name	*Description*
Bitmap file	
Bump mode	Defines how the texture is evaluated to create the bumps
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees
Clip	If set to true, texture will not repeat. Outside of the texture the surface will be flat
Bump strength	
UV space index	Selects a specific UV space

Display name	*Type*	*Parameter*	*Default*
Bitmap file	`uniform texture_2d`	`texture`	
Bump mode	`uniform mono_mode`	`bump_source`	`mono_average`
Tiling	`uniform float2`	`scaling`	`float2(1.0)`
Offset	`uniform float2`	`translation`	`float2(0.0)`
Rotation	`uniform float`	`rotation`	`0.0`
Clip	`uniform bool`	`clip`	`false`
Bump strength	`uniform float`	`factor`	`1`
UV space index	`uniform int`	`texture_space`	`0`

3.12 Normal map texture

MDL identifier: `core_definitions::normalmap_texture`

Allows the use of tangent space normal maps

Display name	*Description*
Normalmap file	
Tiling	Controls the scale of the texture on the object
Offset	Controls position of the texture on the object
Rotation	Rotation angle of the texture in degrees
Clip	If set to true, texture will not repeat. Outside of the texture the surface will be flat.
Strength	
UV space index	Selects a specific UV space
Flip V	Flip handedness of the tangent space

Display name	*Type*	*Parameter*	*Default*
Normalmap file	`uniform texture_2d`	`texture`	
Tiling	`uniform float2`	`scaling`	`float2(1.0)`
Offset	`uniform float2`	`translation`	`float2(0.0)`
Rotation	`uniform float`	`rotation`	`0.0`
Clip	`uniform bool`	`clip`	`false`
Strength	`uniform float`	`factor`	`1`
UV space index	`uniform int`	`texture_space`	`0`
Flip V	`uniform bool`	`flip`	`false`

3.13 Blend normals

MDL identifier: `core_definitions::blend_normals`

Blend two normals or apply a detail normal map

Display name	*Description*
Base normal	The base normal
Base normal weight	Specifies the strength of the base normal using a linear blend between state::normal and “base_normal”
Detail normal	The detail normal
Detail normal weight	Specifies the strength of the detail normal using a linear blend between state::normal and “detail_normal”

Display name	*Type*	*Parameter*	*Default*
Base normal	`float3`	`base_normal`	`state::normal()`
Base normal weight	`float`	`base_normal_weight`	`1.0f`
Detail normal	`float3`	`detail_normal`	`state::normal()`
Detail normal weight	`float`	`detail_normal_weight`	`1.0f`

4 Enumerations

4.1 User interface group

MDL identifier: `core_definitions::material_type`

User interface grouping hint for materials

Field	*Index*	*Description*
`simple_material`	0	Simple material
`complex_material`	1	Complex material
`combiner_material`	2	Combiner material
`modifier_material`	3	Material modifier

4.2 Emission mode

MDL identifier: `core_definitions::emission_type`

Emission mode definition for light sources

Field	*Index*	*Description*
`lumen_m2`	0	lumen/m2
`lumen`	1	lumen
`candela`	2	candela
`nit`	3	nit (candela/m2)

4.3 Worley noise cell type

MDL identifier: `core_definitions::cell_type`

Behavior of the Worley noise cell

Field	*Index*	*Description*
`simple_cells`	0	Simple cells
`crystal_cells`	1	Crystal cells
`bordered_cells`	2	Bordered cells

4.4 Worley noise cell shape

MDL identifier: `core_definitions::cell_base`

Shape of the Worley noise cell

Field	*Index*	*Description*
`circular_cells`	`0`	Circle base
`diamond_cells`	`1`	Diamond base

