Principled BSDF

The *Principled* BSDF that combines multiple layers into a single easy to use node. It can model a wide variety of materials.

It is based on the OpenPBR Surface shading model, and provides parameters compatible with similar PBR shaders found in other software, such as the Disney and Standard Surface models. Image textures painted or baked from software like Substance Painter may be directly linked to the corresponding input in this shader.

Layers

The base layer is a mix between metal, diffuse, subsurface, and transmission components. Most materials will use one of these components, though it is possible to smoothly mix between them.

The metal component is opaque and only reflect lights. Diffuse is fully opaque, while subsurface also involves light scattering just below the surface. Both diffuse and subsurface sit below a specular layer. The transmission component includes both specular reflection and refraction.

On top of all base layers there is an optional glossy coat. And finally the sheen layer sits on top of all other layers, to add fuzz or dust.

Light emission can also be added. Light emits from below the coat and sheen layers, to model for example emissive displays with a coat or dust.

Inputs

Base Color

Overall color of the material used for diffuse, subsurface, metal and transmission.

Same base color for multiple materials types

Roughness

Specifies microfacet roughness of the surface for specular reflection and transmission. A value of 0.0 gives a perfectly sharp reflection, while 1.0 gives a diffuse reflection.

Roughness from 0.0 to 1.0

Metallic

Blends between a dielectric and metallic material model. At 0.0 the material consists of a diffuse or transmissive base layer, with a specular reflecti layer on top. A value of 1.0 gives a fully specular reflection tinted with the base color, without diffuse reflection or transmission.

Metallic from 0.0 to 1.0

IOR

Index of refraction (IOR) for specular reflection and transmission. For most materials, the IOR is between 1.0 (vacuum and air) and 4.0 (germanium). The default value of 1.5 is a good approximation for glass.

IOR from 1.0 to 2.0

Alpha

Controls the transparency of the surface, with 1.0 fully opaque. Usually linked to the Alpha output of an Image Texture node.

Alpha from 0.0 to 1.0

Normal

Controls the normals of the base layers.

Diffuse

Roughness **Cycles Only**

Surface roughness; 0.0 gives standard Lambertian reflection, higher values activate the Oren-Nayar BSDF.

Subsurface

Subsurface scattering is used to render materials such as skin, milk and wax. Light scatters below the surface to create a soft appearance.

Method

Rendering method to simulate Subsurface scattering.

Christensen-Burley:

An approximation to physically-based volume scattering. This method is less accurate than *Random Walk* however, in some situations this method will resolve noise faster.

Random Walk:

Cycles Only Provides accurate results for thin and curved objects. Random Walk uses true volumetric scattering inside the mesh, which means that it works best for closed meshes. Overlapping faces and holes in the mesh can cause problems.

Random Walk (Skin):

Cycles Only Random walk method optimized for skin rendering. The radius is automatically adjusted based on the color texture, and the subsurface entry direction uses a mix of diffuse and specular transmission with custom IOR. This tends to retain greater surface detail and color and matches measured skin more closely.

Weight

Blend between diffuse surface and subsurface scattering. Typically should be zero or one (either fully diffuse or subsurface).

Weight from 0.0 to 1.0

Radius

Average distance that light scatters below the surface. Higher radius gives a softer appearance, as light bleeds into shadows and through the objec The scattering distance is specified separately for the RGB channels, to render materials such as skin where red light scatters deeper. The X, Y an Z values are mapped to the R, G and B values, respectively.

Radius from white to red

Scale

Scale applied to the radius.

Scale from 0 cm to 50 cm

IOR **Cycles Only**

Index of refraction (IOR) used for rays that enter the subsurface component. This may be set to a different value than the global IOR to simulate different layers of skin.

IOR from 1.0 to 2.0

Anisotropy **Cycles Only**

Directionality of volume scattering within the subsurface medium. Zero scatters uniformly in all directions, with higher values scattering more strong forward. For example, skin has been measured to have an anisotropy of 0.8.

Anisotropy from 0.0 to 1.0

Specular

Controls for both the metallic component and specular layer on top of diffuse and subsurface.

Distribution

Microfacet distribution to use.

GGX:

A method that is faster than *Multiple-scattering GGX* but is less physically accurate.

Multiscatter GGX:

Takes multiple scattering events between microfacets into account. This gives more energy conserving results, which would otherwise be visible as excessive darkening.

IOR Level

Adjustment to the IOR to increase or decrease intensity of the specular layer. 0.5 means no adjustment, 0 removes all reflections, 1 doubles them normal incidence.

This input is designed for conveniently texturing the IOR and amount of specular reflection.

IOR level from 0.0 to 1.0

Tint

Color tint for specular and metallic reflection.

For non-metallic tints provides artistic control over the color specular reflections at normal incidence, while grazing reflections remain white. In reality non-metallic specular reflection is fully white.

For metallic materials tints the edges to simulate complex IOR as found in materials such as gold or copper.

Tint from white to orange

Anisotropic Cycles Only

Amount of anisotropy for specular reflection. Higher values give elongated highlights along the tangent direction; negative values give highlights shaped perpendicular to the tangent direction.

Anisotropic from 0.0 to 1.0

Anisotropic Rotation Cycles Only

Rotates the direction of anisotropy, with 1.0 going full circle.

Compared to the *Glossy BSDF* node, the direction of highlight elongation is rotated by 90°. Add 0.25 to the value to correct.

Anisotropic rotation from 0.0 to 1.0

Tangent

Controls the tangent direction for anisotropy.

Transmission

Transmission is used to render materials like glass and liquids, where the surface both reflects light and transmits it into the interior of the object

Weight

Mix between fully opaque surface at zero and fully transmissive at one.

Weight from 0.0 to 1.0

Coat

Coat on top of the materials, to simulate for example a clearcoat, lacquer or car paint.

Weight

Controls the intensity of the coat layer, both the reflection and the tinting. Typically should be zero or one for physically-based materials, but may l textured to vary the amount of coating across the surface.

Weight from 0.0 to 1.0

Roughness

Roughness of the coat layer.

Roughness from 0.0 to 1.0

IOR

Index of refraction (IOR) of the coat layer. Affects its reflectivity as well as the falloff of coat tinting.

IOR from 1.0 to 2.0

Tint

Adds a colored tint to the coat layer by modeling absorption in the layer. Saturation increases at shallower angles, as the light travels farther throug the medium, depending on the IOR.

Tint from white to blue

Normal

Controls the normals of the *Coat* layer, for example to add a smooth coating on a rough surface.

Sheen

Sheen simulates very small fibers on the surface. For cloth this adds a soft velvet like reflection near edges. It can also be used to simulate dust on arbitra materials.

Weight

Controls in the intensity of the sheen layer.

Weight from 0.0 to 1.0

Roughness

Roughness of the sheen reflection.

Roughness from 0.0 to 1.0

Tint

The color of the sheen reflection.

Tint from white to green.

Emission

Light emission from the surface.

Color

Color of light emission from the surface.

Emission color variations

Strength

Strength of the emitted light. A value of 1.0 ensures that the object in the image has the exact same color as the *Emission Color*, i.e. make it 'shadeless'.

Strength from 0.0 to 10.0

Thin Film Cycles Only

Thin Film simulates the effect of interference in a thin film sitting on top of the material. This causes the specular reflection to be colored in a way which strongly depends on the view angle as well as the film thickness and the index of refraction (IOR) of the film and the material itself.

This effect is commonly seen on e.g. oil films, soap bubbles or glass coatings. While its influence is more obvious in specular highlights, it also affects transmission.

> Note
>
> Thin-film interference is currently only applied to dielectric materials. Support for thin films on top of Metallic is planned in the future.

Thickness

The thickness of the film in nanometers. A value of 0 disables the simulation. The interference effect is strongest between roughly 100 and 1000 nanometers, since this is near the wavelengths of visible light.

IOR

Index of refraction (IOR) of the thin film. The common range for this value is between 1.0 (vacuum and air) and roughly 2.0, though some materia can reach higher values. The default value of 1.33 is a good approximation for water. Note that when the value is set to 1.0 or to the main IOR of the material, the thin film effect disappears since the film optically blends into the air or the material.

Outputs

BSDF

Standard shader output.

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Principled Hair BSI

Previous
Metallic BSDF

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