# 梦幻色彩创造的八个黄金法则

# Eight Golden Rules for a Fantastic Colour Creation

奇幻的色彩和效果使汽车表面翟翟生辉。尤其是在80年代中期引入汽车OEM涂料行业的干涉颜料，具有这样的效果。第一个白色干涉颜料系列应用于三层体系中，包括白色底漆、白色干涉涂层及透明面漆涂层。
之后，彩色涂层成为趋势，包括吸收性彩色颜料、白色以及彩色干涉颜料的混合体系。

—— Mr.Werner Rudolf Cramer 先生, Germany 德国
info@wrcramer.de

到90年代末，有一段时期人们通过在这些彩色系统中引入铝颜料来增强表面效果。由于现代生产方法的影响，这类颜料也逐步进步，实现新奇效果并仍将继续实现这些效果。便携式颜色测量设备的引入也促进了当今色彩系统的发展。与视觉颜色匹配相比，它们使生产、工作流程以及来料的监测更容易掌握（**图1**）。

## 注意几何图形！

在大多数情况下，现代汽车涂料要么改变亮度要么一并改变亮度和颜色。几何图形的结果与照明和观察的位置之间的角度有关。

Exciting colours and effects make modern automotive finishes radiate. Interference pigments, introduced in the mid-80s for automotive OEM coatings, especially have this effect. The first colour series with white interference pigments were applied in a three-layer system using a white basecoat, white interference coat and a clear coat. After that, the trend turned to coloured coatings with mixtures of absorbent coloured pigments and white as well as coloured interference pigments.

At the end of the 90s, these colour systems were enhanced through the introduction of aluminum pigments, which had been used for some time for effect finishing. This pigment type also evolved, for which novel effects were achieved and still continue to be reached due to modern production methods. The introduction of portable colour measuring devices also contributed to the development of today's colour systems. They make production and work

**图1：黑色、白色和银色是世界各地的最爱。只有极少数大胆的色调成为OEM面漆**
**Figure 1: Black, white and silver are favourites around the world. Very few bold colours become an OEM finish.**

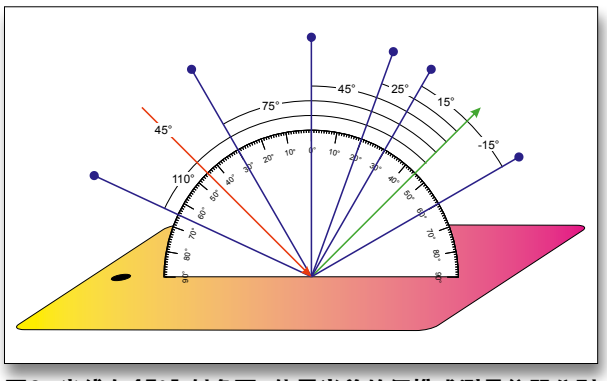


**图2：光线在45°入射角下，使用当前的便携式测量仪器分别在观察角度为-15°、15°、25°、45°、75°和110°测量**
**Figure 2: Illumination is measured at 45° with the current portable measuring instruments and respectively at -15°, 15°, 25°, 45°, 75° and 110° from the observation angle.**

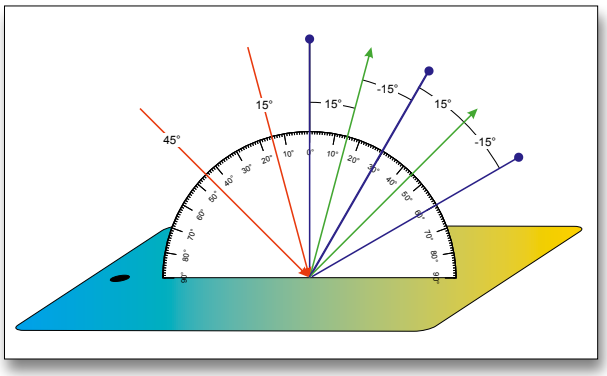


**图3：ASTM标准E2539设置两个固定角度的照明装置测量干涉颜料在15°和45°的光照。分别在-15°和+15°的两个镜面反射角进行测量**
**Figure 3: The ASTM standard E2539 sets two fixed angles of illumination for measuring interference pigments at 15° and 45°. Measurements occur respectively at -15° and +15° from each specular angle.**

光源-通常是太阳，在一个可量化的角度照亮了车辆，并且在与法线相同的角度被反射出去。法线垂直于车身上某一点，在这点光线被反射出去。同照射光一起，法线和反射光处于同一层。在这一层，角度是通过法线来定义的：照射角度45°表示光源照射到车辆上偏离法线45°的位置。因此照射角度为45°。

镜面角度对应于照射角度；由于一些实际原因，这些角之前是负的，这在物理上是不正确的。如果人们观察车辆的光泽，光泽和观察位置之间的镜面角将为0°。当远离光泽时，逆向反射角逐渐增大。仪器制造商通常参考的逆向反射角度有 -15°、15°、25°、45°、 75°和110°。相应的绝对观察角分别为-50°、-30°、-20°、0°、30°和65°（**图2**）。

彩色的光干涉颜料（见下一个规则）的特点是当照射角度发生变化时颜色也会发生变化。理想情况下，它是在偏离法线15°、45°、65°的角度，分别通过陡峭的、经典的、水平的光源照射，分别在15°的镜面

processes as well as incoming inspections easier to handle compared to visual colour matching (**Figure 1**).

## Mind the geometries!

In most cases, modern automotive coatings have an effect that changes either the lightness or both the lightness and colour. Depending on the location of the illumination and the location of observation, geometries result that relate to the appropriate angle.

The light - usually the sun – illuminates the vehicle under a quantifiable angle and is reflected from it at the same angle to the normal. The normal is perpendicular on a point of the car body where the light is reflected. Together with the illumination, the normal and the gloss (=reflected light) form a layer. In this layer, the angle is defined by the normal: illumination of 45° means that the light source illuminates the vehicle from the normal at an angle of 45°. The illumination angle is therefore 45°.

The specular angle corresponds to illumination angle; for practical reasons, the angle is preceded by a minus sign, which is physically incorrect. If one were to observe the gloss of the vehicle, the aspecular angle between gloss and observation would be 0°. When moving away from the gloss, the aspecular angle becomes greater. The manufacturers of instruments refer to this aspecular angle, which usually is -15°, 15°, 25°, 45°, 75° and 110°. Accordingly, the corresponding and absolute observation angles are -50°, -30°, -20°, 0°, 30° and 65° (**Figure 2**).

Coloured interference pigments (see next rule) are characterised by a shift in colour when the angle of illumination is changed. Ideally, it is measured with a steep, classic and flat illumination at 15°, 45° and 65° from the normal, respectively at 15° from the specular angle.

Unfortunately, such measurements are not possible with portable devices because they only work with one or two illumination angles. However, you can make it easier on yourself by measuring 15°/as 15°, 45°/as 15° and 45°/as -15° or at 45°/as 15° and 45°/as -15°, instead of 15°/as 15°, 45°/as 15° and 65°/as 15° (illumination angle / aspecular angle) (**Figure 3**).

## Get to know effect pigments

While coloured pigments partially absorb the incoming light and partially scatter it undirected in all directions, interference pigments divide the incoming light. Particularly in the case of transparent pigment types, one can recognise the intense reflection colour and the transmission colour, which is complementary to the reflection colour: if a white light strikes the surface of a transparent interference pigment then it will be partially reflected. The other part travels through the highly refractive metal oxide layer and in turn partially reflects on the boundary layer to the substrate (e.g. mica, aluminium oxide, silicon oxide). This reflected portion exits the pigment parallel to the first reflection elements. Both components interfere with each other: displacement of the corrugation peaks and valleys occurs due to the longer path of the second element happening simultaneously. If there are successive corrugation peaks, then the resulting peak is amplified. If the peaks and valleys coincide, then the resulting peak is reduced. Light waves of certain wavelengths are selectively reflected depending on the thickness of the highly refractive layer (or layers), the refractive indexes and the angle of the incoming light.

角度进行度量。不幸的是，这种测量是不可能通过便携式设备测量的，因为只使用一个或两个照明角度。然而，可使其简化通过测量标记15°/15°，45°/15°和45°/-15°或者是45°/15°和45°/-15°而不是15°/15°、45°/15°和65°/15°（照射角/逆向反射角）（**图3**）。

## 了解效果颜料

由于彩色颜料能够部分吸收、部分散射入射光到不同的方向，光干涉颜料把入射光分散。尤其是透明类型的颜料，它们可识别反射和透过的颜色，这是反射颜色的互补色：如果一个白色的光照射到一个透明的光干涉颜料表面那么就会被部分反射。另一部分透过高折射率的金属氧化物层然后反过来部分反射到了基材（如云母、氧化铝、氧化硅）的边界层。这个反射部分缺少的颜色平行于第一反射元素。这两个组分之间相互干涉，与路径较长的第二元素同时发生导致了峰顶和峰谷位移的起伏。如果同时产生连续的波峰则其峰值增大。如果高峰和低谷同时产生则峰值减小。特定波长的光波被选择性地反射取决于高折射率层的厚度、折射指数以及入射光的角度。

光线穿透透明干涉颜料，在颜料背面发生类似的过程，也产生干涉。因为光从光密介质到光疏介质时传播方向发生改变。因此，传输的颜色和反射的颜色互补：如果干涉颜料反射的颜色为蓝色，则它的传输颜色为黄色。当颜料在透明或者白色基材上应用的时候可观察到：当表面出现的颜色是红色的时候，传输颜色是绿色（**图4**）。

光干涉颜料有很多种类型，可根据它们的产生方式进行大致区分：透明或者半透明的干涉颜料是采用湿化学法制备的，其载体包括天然云母、氧化铝、氧化硅。这些载体板可包覆一层金属氧化物如二氧化钛、氧化钛或者氧化铬。最常见的是具有二氧化钛涂层的光干涉颜料。二氧化钛可提供色谱上的所有颜色，氧化铁可制造紫铜颜料，二氧化钛和氧化铁的结合可制造黄金颜料。制造商通常可提供不同细微性的干涉颜料：细微性更小的颜料比正常细微性的颜料更蓝。

The rays of light that penetrate the transparent interference pigments experiences something similar on the backside of the pigment and also interferes. Since the rays of light change from optically denser to optically thinner media the phase shift is absent. For this reason, the transmission colour complements the reflection colour: if the interference pigment reflects blue, then its transmission colour is yellow. This can be observed when the pigment on a transparent film or a white substrate is applied: the colour perceived on the surface appears to be red while the transmission colour is green (**Figure 4**).

There are different types of interference pigments, which can roughly be distinguished according to how they were produced: transparent or semi-transparent ones are made in wet-chemical processes for which the carrier materials consist of natural mica, aluminium oxide or silicon oxide. These carrier plates can be coated with metal oxides such as titanium dioxide, iron oxide or chromium oxide. The most common are interference pigments with titanium dioxide coating. Titanium dioxide provides all the colours of the colour wheel, iron oxide can produce red-copper pigments and a combination of the two oxides can produce yellow-golden pigments. Many of the interference pigments are also offered in different sizes by the manufacturers: finer fractions are usually bluer than the normal-sized pigments.

## Apply specific interference pigments

Effect pigments achieve their strongest effect in sunlight. The effect is reduced dramatically in cloudy weather. Basically, it can be said that modern interference pigments have narrower gloss ranges than classical interference pigments, meaning that a few angular degrees away from the specular angle decreases the gloss drastically (**Figure 5**).

Since interference pigments are mostly transparent (also glass flakes), appropriate pigments need to be added to the coating formula: by mixing transparent interference pigments with blue or green coloured pigments the transparency of the mixture decreases. Simultaneously, the chroma initially increases only to decrease again after a certain point. This phenomenon is also common in white colour mixtures: a blue pigment or a corresponding paste is usually bluish black. When more white is added the mixture becomes more colourful (blue) until a certain point. Beyond this point of the highest chroma, the mixture starts to become pale and achromatic again and starts to become whiter.

## Use aluminium pigments wisely

Similarly to the interference pigments, there are differences in pigment size in this type of pigment: fine pigments have

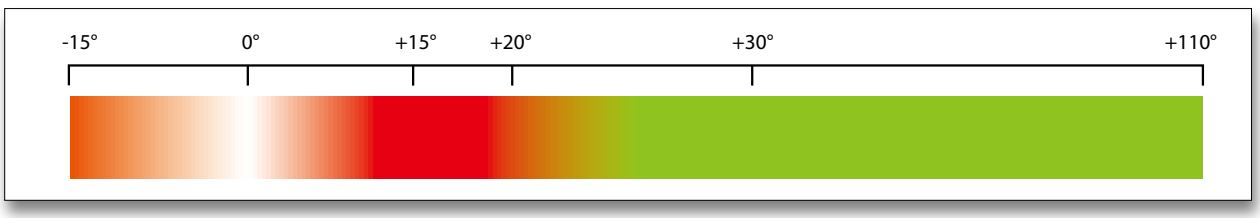


**图4：彩色干涉颜料显示出取决于镜面反射角的显著颜色变化**
**Figure 4: Coloured interference pigments show significant colour changes depending on the aspecular angle.**

## 应用特别的干涉颜料

效果颜料在阳光下可发挥其最强的作用。这样的效果在多云的天气会大打折扣。基本上可这样说，现代干涉颜料同传统干涉颜料相比，具有较窄的光泽范围，也就是说，这意味着与镜面反射角存在几个角度的偏离，导致光泽度急剧减小（**图5**）。

因为干涉颜料大多是透明的（也叫玻璃薄片状），合适的颜料需要被加入到涂料配方中：通过将透明干涉颜料与蓝色或绿色的有色颜料混合，混合物的透明性会降低。同时，最开始色度会增加到某一个特定点之后会再次减小。这种现象在白色颜料混合物中很常见：蓝色颜料或对应色浆通常为蓝黑色。当加入更多的白色颜料，混合物会变得更加丰富多彩（蓝色），直到达到某一特定点。当超过该点处的最高色度后，该混合物又开始变得苍白，并且消色后再次开始变得更白。

## 科学地使用铝颜料

与干涉颜料类似，这种颜料也有颜料尺寸大小差异，精细的颜料具有较低的光泽度（绸缎光泽），而粗

**图5：彩色干涉颜料提供颜色之间的平滑过渡，它们应用于许多涂料配方**
**Figure 5: Coloured interference pigments provide smooth transitions between colours, and they are used in many coating formulas.**

a lower gloss (satin gloss), whereas coarse pigments have a much stronger one. However, increasing coarseness decreases the hiding power. Different pigment sizes are offered by manufacturers. In addition to classifications according to size, aluminium pigments are also distinguished according to how they were produced and the resulting optical characteristics: normal aluminium pigments are formed by atomising aluminium, through which small particles that resemble potato tubers are formed. When they are flattened,

糙的颜料具有较强的光泽度。但是增加粗糙度会降低遮光能力；不同大小尺寸的颜料由制造商提供。铝颜料除了按大小分类，也可根据生产方法以及所具有的光学特性区分；普通的铝颜料由铝粉末雾化形成，形成的小颗粒类似于马铃薯块茎；当将其铺平后成为铝颜料，由于具有不规则的形状因此被命名为“玉米片”；当雾化过程用惰性气体保护，结果就会形成小圆珠，这些圆形颜料铺平之后称之为“银元”。铝颜料，例如舒伦克公司的AluMotion，具有尺寸范围从11至24微米的“玉米片”和尺寸范围从14至34微米的“银元”而有所不同（均为D50值）（**图6**）。

银元铝颜料可更强烈地接近光的光泽进行反射，这就大大降低了光的光泽的偏离；这两种类型的颜料复合使用，用作干涉颜料可控制颜料的光泽特性。镜面值是当光相对于镜面几何形状为15°、25°、45°、75°和110°角度时是光亮度；在25°和45°角度之间的光亮度的差异特别明显，因此，应当注意到这些角度之间的差异大小是不同的（**图7**）。

they become aluminium pigment and are given their name because of their irregular appearance as “cornflakes”. When the atomisation process with inert gas is carried out, then the result is small beads, which when flattened lead to round pigments called “silver dollars”. Aluminium pigments, for example, the kind from AluMotion from Schlenk, vary in sizes ranging from 11 µm to 24 µm for the cornflakes and 14 µm to 34 µm for the silver dollars (each D50) (**Figure 6**).

Silver dollar aluminium pigments have a stronger reflection of the light close to the gloss, which greatly decreases further away from the gloss. Both types of pigment are used in combination with interference pigments to control the gloss behaviour of the colour creation. This is portrayed well when the aspecular values of the lightness for the geometries of 15°, 25°, 45°, 75° and 110° are compared to the specular angle. Strong differences in lightness are particularly evident at the angles between 25° and 45°. It should, however, be noted that the differences between these angles are in different sizes (**Figure 7**).

In a visual assessment – for example, when tilting the test panel at the window – the illumination and observation angles change. During this process, the positions of the illumination (sun) and the observer, and thus the angle

**图6：显然可看出正常红色和金属红色（左）之间的差别**
**Figure 6: Clearly one can see the difference between a normal red and a metallic red (left).**

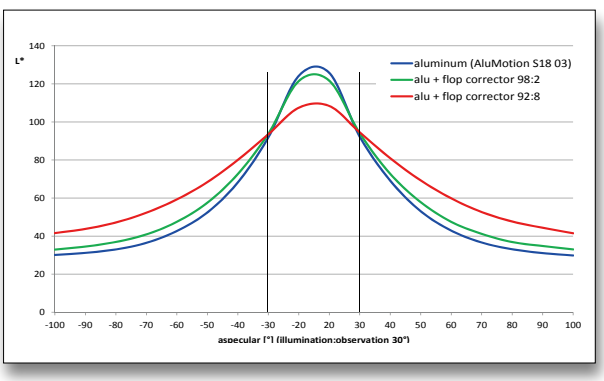


**图7：添加剂可影响铝颜料的反应。这里的光亮度已通过触发校正器减少到接近某一光泽度，且可让其远高于该光泽度**
**Figure 7: Additives can influence the reaction of aluminium pigments. Here, the lightness has been reduced with a flop corrector close to the gloss, and increased away from the gloss.**

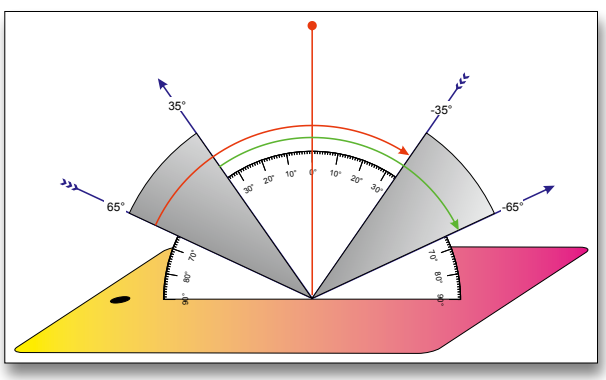


**图8：如果一个测试板由观察者控制来回倾斜，例如，在视窗-光源和观察者之间的镜面反射角不变：保持在30°**
**Figure 8: If a test panel is tilted back and forth by the observer – for example, at the window – the aspecular angle between the light source and the observer does not change: it remains at 30°.**

在视觉评估时——举个例子，当测试板倾斜在视窗的时候——入射光照和观察者观察的角度会变化。在这个过程中，如果入射光照（太阳）和观察者之间的位置保持不变，观察者观察到的几何形状与测量仪器不匹配，这样就要求入射光照总是从相同的角度照射（**图8**）。

铝颜料和色浆与着色颜料反应与做白色或者彩色干涉颜料类似；色度先增加，在转捩点以后再次下降，而亮度会再次增加；当混合新颜料时必须牢记这种变化。

记住铝颜料能接近光的光泽发生更强烈的反射同样重要，因此能得到比干涉颜料更高的光亮度：将铝颜料与白色干涉颜料混合，明亮度会增加。

## 选择期望的颜色范围

如果你想创造一个新的颜色，不管有没有效果，你都必须知道该怎么做。一方面，我们有可能从一种特殊的效果颜料开始，并观察它相应的反应。比如说，如果你选择了一种多彩的干涉颜料，那么第一步应该用黑色颜料与之混合，以确定其效果。下一步是用蓝色或绿色着色颜料或相应的色浆重复实验。这种干涉颜料的实际颜色和效果可能性可在这些组合中非常快速地识别出来。通过这些尝试，我们会有很多生成各种新颜色的想法，这些颜色可根据OEM应用来制备。

另一方面，人们也可有针对性地控制所期望的颜色范围。众所周知，现代的各系列颜色是不同类型颜料的组合：如果某种颜料的含量在多彩颜料组成中占主导地位，那么这种颜料将决定总体的颜色。另外一种铝颜料可调节混合物的光泽，凭藉这个，你可在精细的铝颜料和粗糙的铝颜料之间做选择，就像在 “玉米片”或“银元”之间做选择一样。其他干涉颜料可用来确定完整的混合物的行为效应。这里同样有一个大范围的选项，打开了通向多种可能性的大门。

例如，如果一开始使用蓝色颜料，然后将白色和彩色的干涉颜料混合在一起。白色的干涉颜料可制造一个银色的效果，而彩色颜料可以创造出更多的色彩效果。甚至金色或紫铜色干涉颜料也可混合以形成蓝色的着色颜料。因为它们具有吸收要素，减色混合行为在这样的混合物之中发生。因此，蓝色颜料和金色干涉颜料混合也能产生美丽的绿色色调。

如果你想混合出光亮的金属色或者银色，那么一开始你就可很方便地选择铝颜料。因为有不同类型和尺寸的铝颜料可选择，通过这一点，我们可决定整个混合物的光泽水准以及粗糙度。随后，有色颜料被添加进去，旨在为颜色的大体方向提供一个色调。干涉颜料也可加入进去，这取决于它的类型以及占整体混合物的比例，这样可得到一个或多或少明显的色彩效果（**图9**）。

**图9：金属色的显现随观察角度发生强烈的强度变化**
**Figure 9: Metallic colours show a powerful change in intensity depending on the observation angle**

between them remain the same. The geometries for the visual observation do not correspond to those of the measuring instruments. This would require that the light source would always have to shine at the same angle (**Figure 8**).

Aluminium pigments and pastes react to coloured pigments similarly as do white or coloured interference pigments: the chroma increases and falls again at the turning point, while the lightness increases once again. This behaviour must be kept in mind when blending a new colour.

It is also important to remember that the aluminium pigments close to the gloss reflect more intensely, and therefore possess a higher degree of lightness than interference pigments: lightness increases in a mixed batch of white interference pigment with an aluminium pigment.

## Select the desired colour range

If you want to create a new colour with or without effect then you have to find out how. On the one hand, it is possible to start with a special effect pigment and observe its reaction. If, for example, you take a colourful interference pigment, then the first step is to mix it with black to determine its effect. The next step is to repeat the experiments with a blue or green coloured pigment or the corresponding paste. The actual colour and effect possibilities of such interference pigments can be very quickly recognised in these combinations. From these trials, a number of ideas arise for new colours, which can be prepared according to the OEM applications.

On the other hand, one can also control the desired colour range in a targeted manner. It is common knowledge that modern series colours consist of a combination of different pigment types: if the pigment content dominates a coloured pigment, then this will determine the overall colour. An additional aluminium pigment regulates the shine effect of the mixture, whereby you can choose between fine to coarse aluminium pigments as well as between “cornflakes” or “silver dollars”. Additional interference pigments allow you to determine the behavioural effect of the complete mixture: here again there is a large range of options that opens the door to many possibilities.

If, for example, you start with a blue coloured pigment, then white and coloured interference pigments are mixed together. White interference pigments give a silvery effect, while colour pigments create greater colour effect. Even gold

**图10：哑光饰面是最新的潮流，但仍然不是那么受欢迎。它们可能会造成OEM涂料方面以及修补维修工作的困难**
**Figure 10: Matte finishes are the latest trend, but are still not that popular. They can pose difficulties in OEM coatings and refinishing repair jobs.**

如果一开始就需要某种效果，我们也可从一种干涉颜料开始。这可通过添加一种着色颜料来进行控制，同时这种着色颜料当中加入一种颜料之后可完全替代它原来的颜色效果。

## 从色彩系统思考

所提供的颜色和异色效应颜料的组合是如此的广阔，当今它几乎可创造出所有的颜色。尽管如此，我们始终要记住，这些颜料是真实的而不是一个理论性质，这一点很重要。因此，不可能产生理想的，甚至是中性的黄色。黄色颜料都具有一个红色或绿色的元素。此外，还有不只有一种红色颜料，而是各种不同类型的红色。这其中的原因，首先是同黄色的一样；其次，红色颜料与白色颜料或者在其它混合物中的反应是不理想的，而且是可发生转变的，例如，可转变成紫色，同时与白色混合的混合物会有更偏蓝的色调。添加有色颜料到混合物中会导致三维样变。它会改变色度（强度）、颜色和亮度：通过加入蓝色颜料使颜料颜色更蓝的同时也意味着改变了颜料的色度和亮度。透明的干涉颜料通常处于这样一种状态，在色彩方面，它们排列在色谱上。因为它们可相互混合，新的效果可在色彩创作过程中实现。干涉颜料的各种共混物对着色颜料做出的反应就像单个干涉颜料一样。

## 遵循混合定律

汽车表面和许多工业产品表面是各种颜料和色浆的典型混合体。不但拥有不同的颜色和效果，而且在混合之后有不同的表现：例如黄色颜料和蓝色颜料混合变成绿色。这被称为减色混合。另一方面，如果透明的干涉涂料比如珍珠黄和珍珠蓝混合之后不是绿色而是白色，称为加色混合。

可想像不同的混合特征，使用黄色和蓝色两种颜色的滤色器作为例子：在减色混合中，这两种滤色器

or red copper interference pigments can be mixed to form a blue coloured pigment. Since they have absorbent elements, subtractive mixing behaviour also occurs in such mixtures. Therefore, blue coloured pigments and gold interference pigments also produce beautiful green hues.

If you want to mix bright metallics or silver, then you can conveniently choose the aluminium pigment at the beginning. Since different types and sizes are offered, the decision for the level of shine and the coarseness of the complete mixture is made at this point. Afterwards, coloured pigments are added that are intended to provide a tint to the general direction of the colour. Interference pigments can also be added, depending on the type and proportions of the overall mixture, to give a more or less pronounced colour effect (**Figure 9**).

If a certain effect is desired from the outset, it is also possible to start with an interference pigment. This can be managed by adding coloured pigments that completely replace the original colour effect through adding another.

## Think in colour systems

The portfolio of colour and effect pigments offered is so expansive that it is possible to make virtually any colour creation nowadays. Nevertheless, it is important to always remember that these pigments are real and not of a theoretical nature. Thus, it is not possible to produce an ideal and therefore neutral yellow. Yellow coloured pigments have either a red or green element. Also, there is not only one red coloured pigment, rather a variety of them. The reason for this is, firstly, the same as for yellow, and secondly, the reaction of red pigments with white or in mixtures is not ideal, and instead can turn to, for example, violet and more bluish hues in mixtures with white. Adding a coloured pigment to a mixture leads to a 3D-like change. It changes the chroma (intensity), the colour and lightness: to make a colour bluer by adding a blue coloured pigment also means changing the chroma and lightness.

The transparent interference pigments are generally positioned in such a way, in terms of colour, that they are arranged in a colour wheel. Since they can be intermixed, new effects can be achieved in colour creations. The various blends of the interference pigments respond to coloured pigments just like the individual interference pigments.

## Obey the mixing laws

Automobile finishes and many industrial mixtures are typically blends of various pigments or pastes. These not only have different colours and effects, but also behave differently when mixed: coloured pigments such as yellow and blue are combined to make green. This is referred to as subtractive mixing. If, on the other hand, transparent interference pigments such as pearl yellow and pearl blue are blended together, the result is not green, but a white. They mix additively.

It is possible to imagine the different mixing characteristics by using two colour filters in yellow and blue as an example: in subtractive mixing these two filters are in a line. The first filter – the yellow one, for example – first filters out all wavelength ranges from the white light except for the yellow range. After that, the second one, the blue filter filters

在一条直线上。举个例子，第一个黄色的滤色器从白光中过滤掉除了黄光波长范围的其它所有波长的光。然后，第二个蓝色的滤色器过滤掉黄色光谱范围内的所有光。两个滤色器能透过绿光，以至绿色能穿透滤色器成为最后留下来的颜色。

对于加色混合，滤色器是与另外一个是平行的：在这种情况下，黄光滤色器允许黄光光谱范围内的所有光线通过，蓝色滤色器允许蓝色光谱范围内的所有光线通过，两个过滤元素叠加再次呈现白色。

干涉颜料将入射光分成两部分，几乎不吸收光。在这方面，可视它们为最小的光源，当混合时增加不同的光和颜色：珍珠红和珍珠蓝混合可产生紫色，混合红色和蓝色颜料却不能产生足够的紫色色调，这也是为什么红色和蓝色不能混合产生紫色的原因，但是紫色颜料的使用也是出于此目的。

为了在某个方向上改变颜料的颜色，可很便利地使用邻近的颜料或具有相似色彩的颜料：蓝色和红色混合不能变的更红，但是与紫色可以。一种黄色的颜料与橙色颜料混合能变得更红。在这种情况下，红色的颜料与红黄色很快混合成红色，而黄绿却不行。

## 找到创造特别颜色的方法

最标准的颜色如白色、黑色和银色是正常的没有过多修饰的颜色创造。这样的颜色吸引了大批购车者同时避免了关于颜色品味的讨论。对于这样的颜色，买家也没有异议，他们也可能还有一辆橙色或粉红色的汽车。

然而，总有一种特殊类型的表面和颜色的要求：汽车制造商提供了重复性不能保证的表面或哑光清漆。因此，完成一个哑光效果的表面的具体程度取决于温度和湿度等各种参数（**图10**）。

因为额外的成本，汽车买家通常可订购特殊的最不寻常的颜色。这不仅仅是关于有非凡效果的奇异的颜色，即使是不太显眼的颜色创造也能找到他们的方式进入这一特殊的报价。

各种各样的颜色和效果是如此广阔以至于第一眼选择或发现新的颜色是很难的。这就是为什么你可遵循这三个运用现代色彩的实例：创造一个灿烂的白色，避免添加赭石或类似的颜料。有一点蓝能使白色变成一个明亮的白色。创作一个相应的白色的效果，使用纯粹的白色干涉颜料而不是一种基于天然云母的干涉颜料。在更高的镜面角度它们不呈现出微黄色。

令观看者炫目的色彩效果可通过干涉颜料完美制造。这些颜料可以或多或少地和彩色颜料随意混合在一起。应用这些颜料允许您控制的不仅是色彩的作用，还有色彩的色度。总之，存在这么多的迷人的干涉颜料和铝颜料可利用，他们的全部潜力还远远没有用尽。

out all rays of light in the yellow spectral range. Both filters are permeable to green so that at the end green remains as the resulting colour left in this filter.

For additive mixing, the filters are parallel alongside one another: in this case, too, the yellow filter allows all the light rays of the yellow spectral range to pass through and the blue filter allows all the light rays of the blue spectral range to pass through. Both filtered elements then add up to white again.

Interference pigments divide the incoming light into two parts and absorb almost none of this light. In this respect, they can also be seen as the smallest sources of light, adding their different lights and colours when mixed: pearl red and pearl blue make violet; mixing red and blue colour pigments does not create a sufficient violet hue, which is why red and blue are not mixed to make violet colour creations, but instead violet pigments are used for this purpose.

To shift a colour for colour pigments in a certain direction, you can conveniently use neighbouring pigments or pigments with a similar tint: a blue does not become more reddish with a red, but with a violet. A yellow becomes more reddish when mixed with an orange. In this case, a red would mix too quickly into the red; and one does not begin with a greenish yellow, but with a reddish yellow.

## Find an extraordinary colour creation

Most standard colours like white, black and silver are normal colour creations without much zest. Such colours help to attract a large number of car buyers while generally avoiding a discussion about tastes in colour. The buyers also do not have problems with such colours, which they might have had with a car in orange or pink.

Nevertheless, there are always requests for a special type of finish and colour: car manufacturers offer finishes with coloured or matte clear coats for which the reproducibility cannot necessarily be guaranteed. Thus, the degree of matting of a matte finish depends on various parameters, such as temperature and humidity during application (**Figure 10**).

For an additional cost, car buyers can usually order even the most unusual colours, which are offered as special colours. This is not just about exotic colours with extraordinary effects, even less conspicuous colour creations find their way into this special offer.

The variety of colours and effects is so expansive that selecting or discovering a new colour is hard to do at first glance. That is why you can follow these three examples of modern colours that apply to today's taste in colour: to create a radiant plain white, avoid adding ocher or similar pigments. A little blue does wonders to make the white turn into a bright white. To create a corresponding white as a white effect, use a pure white interference pigment instead of an interference pigment based on natural mica. These do not appear yellowish at higher aspecular angles.

Colour effects that dazzle the onlooker can be optimally created using coloured interference pigments. These pigments can be more or less haphazardly mixed together and with colour pigments. Applying such pigments allows you to control not only the colour effects, but also their chroma. All in all, there are so many fascinating interference and aluminium pigments available that their full potential is still far from being exhausted.