Special effect pigments are unique materials employed in cosmetic formulations for captivating colour appearance. As a general format, specific pigment effects are dependent on the substrate material’s inherent properties. More complex materials such as those offering colour travel effect contain a layered matrix structure of materials which are responsible for varying colour within the same material. Substrates used within the cosmetic industry include mica, synthetic mica, and borosilicate and their respective properties will be discussed, particularly focusing on Moonshine® special effect pigments based on glassflake substrates and Kobopearl perpetual pearlescent pigments relying on a synthetic fluorophlogopite substrate.

**Pigments**

Pigments are visually appealing colorant materials with dominance in the colour cosmetic industry. Pigments take on a characteristic colour by reflecting, scattering and absorbing various wavelengths of incident light. The light that is reflected off of a substance gives a high concentration colour appearance. Individual colours have their own unique wavelength and the human eye has the ability to discern only a fraction of the magnetic spectrum called visible light. Lower wavelengths encompass radio, microwave and infrared while higher frequencies include ultraviolet, X-ray and gamma rays. Additionally, the ultimate pigment appearance is dependent on the colour of the source light. Pigments have been used for thousands of years initially by way of naturally occurring materials for art and decorative uses. Now cutting edge technology has brought immense possibilities in creating novel synthetic materials which have a broad range of applications.

**Glassflake special effect pigments**

These special effect pigments have a unique borosilicate, glassflake substrate. These particular materials are a planar platelet structure with an average thickness of 1.2 μm. The smooth surface of these glassflakes produces a neutral mass tone, increased transparency, and notable colour intensity. There are two types of sub categories influencing the resulting borosilicate material. One option is for the borosilicate substrate to be coated with high refractive index metal oxides for strong interference colours. This variation will also possess high gloss and transparency. The other option is to coat the borosilicate substrate with metals resulting in intense brilliance. This second option allows for unique effects to be seen in formulation even at low loading levels of the materials. Furthermore, sparkle effects are achieved by employing glassflake material with a larger particle size distribution.

Interference colours depend only on the thickness of the upper and lower metal oxide coating. In the case of titanium dioxide (TiO₂), silver and interference colours will be achieved. Iron oxide will produce earth tone colour effects. A combination of titanium dioxide and iron oxide will result in golden colours. Finally, silver will produce a metal effect.

The interference effect of these materials is caused by the constructive interference of light. These materials are achromatic, highly transparent, have a homogeneous particle thickness and a refractive index of 1.52. The transparency of the material allows for it to be used in conjunction with background colour. Key attributes of the glassflake material are even thickness of the coating layer at the cross-section, cross uniform particle diameter, uniform coverage on substrate edges (Fig. 2), and also controlled composition. The previously mentioned qualities are important attributes of this substrate. These glassflake materials are more transparent and offer more brilliance than mica, however mica possesses a thinner platelet for better feel. Glassflakes are also chemically stable and inert unlike the case of metal pigments that can be compromised by oxidation.

Borosilicate platelets are a non-toxic material used primarily for their decorative qualities within the cosmetic industry although they also have the capacity to provide improved skin feel. The critical parameters for effective performance are their specific morphology and composition. With this said these glassflake pigments are used in cosmetic formulation in analogous applications to that of mica effect pigments. These formulations include lip colours, lip gloss, eye makeup, nail polishes, face and body makeup, hair care products, bath soaps and gels, and skin lotions and creams. These glassflakes may be heat stable depending on the processing environment at a maximum of 500°C. Furthermore, they do not bleed which is an excellent characteristic so as to alleviate some of the challenges facing formulators.

When formulating with these borosilicate glassflake pigment material, it is recommended to use standard mixing equipment for processing as to limit the amount of shear on the material. This will ensure the concentration of the desired effect is not compromised to attrition. Furthermore, cosmetic chemists should base their selection of materials on a variety of parameters since the colour outcome is dependent on them. Effects vary based on particle size diameter, particles that have silky shimmer or sparkle

**Figure 1: Selected colours of perpetual pearlescent pigments.**
effects, the loading level of the pigment in formulation, and finally using the pigment on its own or in combination with other borosilicate glassflakes or even with other pigments.

**Perpetual pearlescent pigments**

Perpetual pearlescent pigments are unique materials that provide exceptional intensity, brilliance, and lustre to colour cosmetic formulations (Fig. 1). Particle sizes for these specialty effect pigments range from 30-120 microns. The colour travel aspect of these pigments is attributed to a dual interference reflection matrix. The compositional layers consist of a synthetic fluorphlogopite substrate which is subsequently coated with either TiO$_2$ or iron oxide layers. The synthetic mica flakes on their own have an inherent pure white colour cast therefore when the material is coated it will produce clean, brilliant effect pigments. These materials produce a magnitude and intensity that supersede the effects that are achieved employing a natural mica flake base. The colour fluctuation is a function of the coating layer thickness on the substrate. These pearlescent pigments consist of a predominate colour and travel to an alternate colour depending on the angle the material is viewed. The pearlescent pigments containing TiO$_2$ offer an indescent display while those containing both TiO$_2$ and iron oxides offer vivid colour travel while providing good opacity. This technology as a whole provides vivid effect pigments possessing intense saturation of colour. Additionally, these pigments are available with an array of hydrophobic surface treatments including isopropyl titanium trisostearate (ITT), and triethoxycaprylylsilane (11S). The purpose of such treatments is to enhance flow, dispersibility, wear, and appearance.

Ideal applicability of these perpetual pearlescent pigments is in colour cosmetics; specifically foundations, face powders, lipsticks, eye shadows, and nail care. Similar to the previously discussed pigments, cosmetic chemist’s selection of appropriate materials for specific formulations will vary depending on several parameters. Ultimate colour is dependent on particle size diameter, components of the dual interference reflection matrix, the loading level of the pigment in formulation, and finally using the pigment on its own or in combination with similar materials.

**Conclusion**

Special effect pigments hold great promise in the field of colour cosmetics. These materials visually captivate the audience by delivering brilliant and intense colour. Moreover, colour travel resulting in colour fluctuation gives an even greater dimension to colour formulations than just a generic matrix of a single colour. Both categories of the described materials offer the formulator a wide variety of options to tailor to their individual needs. Also, in both categories variation exists in particle sizes, colour, initial substrate, substrate coatings, and surface treatment options.

**References**