

Ceramic colors make life more beautiful

Elegant decorations on glass and ceramics: a formula for success from Heraeus

Vibrant colors and artistic decorative patterns are common on tableware, glass and tile. And regardless of the form – plate or tea cup, tile or drinking glass, bottle or pitcher – the demands placed on high-quality decorations continue to rise steadily. Heraeus was already a leading developer of ceramic colors back in 1896, and today creates innovative products that make modern decoration on glass and ceramic wares possible.



Villeroy & Boch, Samarah Purpur.

Things are very different today from the way they were in our grandparents' time. Bright colors and precious metals must now meet tougher requirements. They have to hold up under constant use in everyday life and be able to withstand the dishwasher and microwave, as well as resisting scratches and abrasions.

In addition, decorative materials for glass and porcelain need to meet increasingly stringent legal requirements regarding heavy metal content and release. There are legal limits on lead and cadmium content, thus lead-free colors cannot exceed a lead content of 600 ppm (= 0.06%). In the USA, only lead-free



ceramic systems may be used to decorate tableware. This poses a huge challenge for the developers at Heraeus, because lead is the key component responsible for luster and brilliance in fired colors.



“Whether it’s dishwasher safe or lead-free, developers have put a lot of work into finding the right mixture. From the outside, people can’t see how complex the decoration is on the inside,” states Peer Hesse, Head of Development for Precious Metal Colors at Heraeus. Ceramic colors are comprised of a mixture of several components that are fired onto glass or ceramics. They need to be customized to suit the individual color application method and yield the best possible results after firing. Precious metal preparations consist of soluble precious metal compounds or precious metal powders, organometallic bonding agents as well as resins and solvents. Bright colors are composed of pigments for coloration – usually metal oxides – and a colorless, glasslike melting component (flux). The flux coats the pigment particles and affixes them to the underlayer. After firing, the pigments are encased in a glassy layer. Flux and pigments, precious metals and alloying constituents all need to be carefully balanced. “Targeted modifications to the glass mesh structure of the transparent flux can improve durability in bright



The road from an initial design concept to a market-ready product is a long one indeed. Whether it's precious metal preparations or bright colors, Heraeus products help manufacturers produce high-quality decorations for glass, porcelain or tile.



Did you know?

In the beginning there was bright gold

Heraeus can look back at over a hundred years of experience in developing decorative preparations for glass and ceramic wares. The foundation for bright gold production was laid in 1896 when Heraeus acquired the August Herbst company. After bright gold came bright silver and bright platinum. The ceramics department at the Heraeus platinum melting house continued to develop precious metal preparations. These efforts soon bore fruit, yielding new enamel colors, high-temperature gold that enables quick firing for gold decorations at 1200°C and specialized covercoats for decal manufacturers, to name just a few. Thus Heraeus continued to expand its expertise, rounding out its product spectrum by adding bright colors to its product family.

Today, Heraeus Ceramic Colours is a leading global manufacturer of decorative materials for the ceramic and glass industries. We produce precious metal preparations, glazes, ceramic and organic colors as well as auxiliary materials such as covercoats and various media in seven production facilities around the world. Sales representatives in over 80 countries ensure service that is close to the customer, all over the globe.

colors,” explains Hesse. By contrast, adding a combination of different transition group metals to precious metal preparations strengthens the bond and durability in precious metal alloys. For that reason, each type of substrate – whether glass, porcelain or tile – has an optimized series of colors and precious metal preparations that withstand the demands of everyday life. And that is an art in itself.

From delicate gold borders to colorful patterns

A person looking at an artistically decorated plate may ask: How do they actually get the decorative pattern on there? Tableware or tiles, stoneware or delicate porcelain, drinking glasses or cosmetic bottles – the decorative methods are as varied as the materials themselves. Colors and precious metals can be painted or sprayed, screen or pad printed onto glass and ceramic items.

Screen printing is the main method used in the glass and ceramic industries for producing high-quality decorations in large quantities. It is quick, precise and reproducible. The industries further distinguish between direct screen printing, in which the decoration is printed directly on the item's surface, and indirect screen printing, in which the manufacturer first creates a decorative decal then applies it to the

substrate. Indirect screen printing, or the decal method, is particularly well-suited to complex motifs and objects with a geometric form that does not lend itself to direct printing. In this approach, a colorful pattern is first printed on paper coated with a water-soluble layer of starch gum.



Heraeus' single-fire etching imitation system.

The print image is created in several steps. Screen printing utilizes an extra-fine steel or polyester mesh screen coated with a photosensitive film. Exposing the screen to UV light cures the areas treated with UV rays, while the areas not exposed can be rinsed out with water. A squeegee then presses the ceramic color through these open spaces onto the substrate or decal paper. Each color and precious metal comprises its own printing step, and as such requires a separate screen. Once dry, the printed decorative motif is coated with a covercoat. Then it is steeped in water to loosen it from the paper backing. The decoration, which is not soluble in water, clings to the coating and is released from the paper and pressed onto the ceramic surface with a squeegee to eliminate bubbles. After allowing it to dry again, the manufacturer fires the decorated piece. The organic materials and auxiliary components burn off first, then as the temperature climbs, the ceramic colors melt onto the substrate surface. The precious metal preparations form a sealed, adhesive film only a few micrometers thick. Depending upon the substrate, firing temperatures can range from approx. 480 to 1250°C.

Decorating with a system

The road from an initial design concept to a market-ready product is a long one indeed. In addition to our comprehensive product portfolio, Heraeus Ceramic Colours also



Application of a decal.

offers customized solutions. Heraeus employees with expertise in development and printing technology work to develop and test precious metal preparations, decoration colors and auxiliary materials. Intensive R&D efforts test a wide range of product combinations for client-specific

which coloration pigments and fillers create a film as the solvent in the bonding agent system evaporates, reactive systems cure decorations by means of a chemical reaction. Solvents are generally not part of the formula. The broad spectrum of UV technology's applications offers the user

Screen printing is the main method used in the glass and ceramic industries for producing high-quality decorations in large quantities.



Employees with expertise in our development laboratory and printing technology center develop and test precious metal preparations, decorative colors and additives.

applications until the best product for the customer's process is found. "The key here is to ensure that all product combinations remain compatible and durable during the firing process as well as everyday use," emphasizes Peer Hesse.

But sometimes there's more to it than ensuring good compatibility among decoration materials. Clever combinations can yield new decorative effects with the help of balanced systems of precious metal preparations, colors and auxiliary materials. The result: decoration systems. Heraeus has developed a number of decoration systems that offer manufacturers even more design options. In addition to matte gold systems that emphasize the interplay between matte and bright finishes, the company also offers a single-fire etching imitation system as well. By combining relief structures and precious metal layers over the top of matte underlays, clients now have the opportunity to produce high-quality etched outline decorations on porcelain and bone china without using the corrosive acids that were necessary in the past.

New curing methods arrive on the scene

Faster and environmentally friendly – a modern curing technique makes it all possible: Ultraviolet light dries colors applied to surfaces in mere seconds. In contrast to the physical drying process for colors and coatings, in

so many benefits. It boosts productivity and improves quality, and colors don't dry on the strainer, ensuring consistent printing. Furthermore, printed decal sheets can be stacked immediately, thereby saving space as well. "UV curing is a key component in Heraeus Ceramic Colours' product portfolio, one that is becoming increasingly common in the glass and ceramic decoration industry," concluded Hesse.

Whether it's precious metal preparations or bright colors, whether for glass, porcelain or tile, one thing is certain: Ceramic colors from Heraeus will continue to beautify our world, now and in the future.

Dr. Barbara Schick, Julia Haenlein

Want to know more?

Peer Hesse
Thick Film Materials Division (Ceramic Colours)
W. C. Heraeus GmbH
Heraeusstr. 12-14, 63450 Hanau
Phone: +49(0)6181.35-9333
E-mail: peer.hesse@heraeus.com
Internet: www.heraeus-ceramiccolours.com

