

# **ARA-LT®:**

## **Laser-induced PVD-markings and -coatings for decorative and functional purposes**

### **Introduction**

Although the improvement of laser technology is going on very fast, there are several fields of application, which are not accessible seriously with laser beams until now.

For example the laser treatment of product surfaces without damaging them, the high-contrast and robust marking of glass, the fast coating on large areas are difficult to realize in most cases.

Also the technology “Physical Vapor Deposition” (PVD), a vacuum based method to apply thin films with high quality, is established since many decades – but due to the high production costs only certain markets are accessible.

But if laser technology and PVD can be combined, then many restrictions are abolished.

With the technology of laser-induced PVD-coatings and –markings, “ARA-LT®” (as developed by Ara-Coatings), many different materials can be applied on products: fast, with high quality but for low cost – selectively or fully covering.

### **ARA-LT®: How does it work?**

A transparent PET-film, equipped with a PVD coating, is positioned on the product surface and in the focus of a laser beam.

By using suitable laser parameter settings the PVD coating is melted, released from the PET film and solidificated on the product surface – showing outstanding features there.

The PET film itself acts as carrier only and is not affected by the laser beam and can be removed easily.

A short movie, showing “live” this laser induced transfer of a PVD coating, can be found under:

<https://www.youtube.com/watch?v=j9TuB5XW9GU>

In serial production the speed of marking takes a few microseconds only.

Besides the “simple” transfer the PVD coatings can be oxidized partially or completely through the laser beam, too. Then it is possible to produce different colors for example.

The technology ARA-LT® can be used manually as well as in serial production on site.

Standard marking lasers are suitable for this technology.

### **What are the benefits/USP's of ARA-LT®?**

- The laser-applied PVD-coatings show an excellent adhesion and abrasion resistance. In fig. 1 (left side), a photo of an enamel surface with an ARA-LT® can be seen and on right side a glass surface with a picture made of metal: after treatment both surfaces with steel wool only the base materials were destroyed, but not the marking or the picture.



*Figure 1: Unsuccessful trial to destroy the ARA-LT® marking from the surface on enamel (1) and glass (2)*

- The optical quality (homogeneity, contrast and edge sharpness) is excellent. Fig. 2 shows gold lines (left) and a boat, consisting of fine gold (right)



*Figure 2: Laser-applied gold lines (left) and a golden boat (right)*

- Product surfaces consisting of glass, ceramic, porcelain, plastics or even paper can be treated with ARA-LT® without affecting or damaging the product surface.
- The laser marking and coating speed is much faster as compared to standard laser markings, because an appropriate setting of the laser parameters lead to a “flowing together” of the PVD coating between the laser lines – enabling a homogeneous and dense coating area. Fig. 3 shows an opaque, laser applied high-reflective mirror (left) and a steel layer with brushed appearance (middle). Of course semi-transparent laser mirror coatings are possible, too.
- In addition to decorative PVD-laser markings, also functional layers can be applied on products - like electrically conductive circuits (visible or invisible), antimicrobial films, corrosion resistant top coats or (transparent or opaque) easy-to-clean structures.

One example for the easy-to-clean feature is given in fig. 3, right side: On a glass surface the letters “ARA” were applied with a laser beam – they show a super-hydrophobic behavior (⇒ the water “left” the letters).



*Figure 2: Laser-applied silver mirror (left), brushed steel surface (middle) and selective easy-to-clean coating (right)*

- Based on a single PVD coated PET film different colors and other properties can be generated within only one laser process – just by adjusting the laser parameter settings.
- Only inorganic base materials are used, like metals, alloys, semiconductors, ceramics or stacks/mixtures of them.

### **Conclusion:**

The ARA-LT® technology can be used for many different applications: either “taylored” PVD laser films can be developed or standard PVD coated PET-films can be bought.

## **Questions and answers – FAQ’s**

### **Q1: What should I consider if I want to use the technology?**

A1: First of all, it must be clarified whether it is a standard application (see A2) or an application in which the suitability of the ARA-LT® laser films still has to be proved or new coatings are to be developed (see Q3).

Then it has to be checked if there is already a laser available, if a contract manufacturing is desired or if a laser should be purchased for the purpose (see Q4).

In some cases it will be necessary to build a specific device first, which allows the defined manual or serial production. If necessary, a specialized mechanical engineering company has to be consulted.

Ara-Coatings supports you during the whole way – from the idea to the start of production.

## Q2: Which standard ARA-LT® laser films can be bought?

A2: The following laser-transferring materials are our standards films:

- ARA-LT® "Gold" (Art.-no.: 2.01.101.00 – A2)
- ARA-LT® "Gold+" (Art.-no.: 2.01.101.00 – A3)
- ARA-LT® "Silver" (Art.-no.: 2.02.102.00 – A2)
- ARA-LT® "Aluminium" (Art.-no.: 1.00.108.00 – A1)
- ARA-LT® "Chrome" (Art.-no.: 1.00.106.00 – A1)
- ARA-LT® "Steel" (Art.-no.: 1.00.507.00 – A1)
- ARA-LT® "Grey" (Art.-no.: 1.00.105.00 – B1)
- ARA-LT® "Black" (Art.-no.: 2.00.804.00 – A1)
- ARA-LT® "Hi-Con" (Art.-no.: 3.01.409.00 – A2)  
(For conductor tracks and electrical circuits)

These materials / laser layers can be transferred e.g. on glass, ceramic, marble, porcelain or stone.

## Q3: I have a specific marking / coating request that is not covered by the standard ARA-LT® films and the recommended products - is ARA-LT® suitable anyway?

A3: In such a case, the following procedure has been proved to be very efficient:

(Basically, many materials can be treated with ARA-LT®, e.g. for some plastics, steel or even paper. Also functional layers are possible and not only decorative markings (Q5).)

- a) If necessary, a confidentiality agreement can be signed in advance (bilateral, a standard form may be sent by Ara-Coatings if required).
- b) You send us some sample parts (ideally with a flat surface and not more than 10 cm x 10 cm x 10 cm in size), together with a short description of what to apply for a label or coating and what it should "endure" (e.g. titanium on a porcelain plate that passes dishwasher test).

c) Then, we proceed – free of charge - a sampling and send the parts back to you – together with a description of the works were made.

**Important:** The results after this initial sampling may not meet your expectations completely. Then, however, it is possible in most cases to achieve the goal by a manageable additional effort.

d) When the samples meet your requirements, we can estimate the costs that arise for you when using ARA-LT® for your production.

e) Signing of a cooperation agreement.

f) Finally, it has to be clarified whether or what is to be procured or constructed for a device which allows a defined product or film transport within the time allowed.

g) If necessary, a mechanical engineering company with the necessary expertise will be consulted and involved.

#### **Q4: Can an already existing laser be used for ARA-LT® - or which lasers are suitable for this technology?**

A4: Basically, the following standard marking lasers are suitable: fiber, YAG or MOPA with a power between 5 and 20 W and a wavelength of around 1000 nm.

Upon request, Ara-Coatings will send a list of lasers, already certified for ARA-LT® and corresponding applications. With these lasers you can start directly the relevant markings or coatings.

For all other devices that are generally considered, an examination is required before – which can be preceded by Ara-Coatings.

#### **Q5: What are the USP's of ARA-LT®?**

A5: ● On glass or ceramic surfaces, transferred PVD-markings or coatings show an excellent adhesion and abrasion resistance.

- The optical quality (homogeneity and sharpness of the contour) of the laser transferred markings and coatings is excellent.
- It is also possible to laser-coat surfaces which cannot be marked by a laser in conventional manner or only in poor quality, e.g. glass, white ceramic or paper.
- The laser markings are applied in such a way that they do not alter or affect the product surface.
- Not only decorative but also functional PVD markings and films can be applied (e.g. electrically conductive structures, easy-to-clean or antimicrobial layers).
- The processing speed is much higher, as compared to conventional laser marking and in most cases, no laser lines are visible.
- Starting from a base foil, different color shades and layer properties can be set in a single laser process - because individual components of the laser image are done with different laser parameter settings.
- Only inorganic materials are used, which are ecologically completely harmless, as well as their production.
- Due to the fact that these are very thin layers, given dimensional tolerances are met. In addition, the technology is extremely resource-efficient.
- By using PET films as a carrier for the PVD layers, a very low-cost serial production is possible:
- The generally very high-quality PVD layers can be manufactured cheaply and can be used in a roll-to-roll process, directly on site in production.