Re-FREAM

Re-Thinking of Fashion in
Research and Artist collaborating
development for Urban Manufacturing

Hub “Sustainable Finishing”

Deliverable 6.3
Roadmap of laser-marking of fashion textile and non-textile materials

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S+T+ARTS LIGHTHOUSE Re-FREAM

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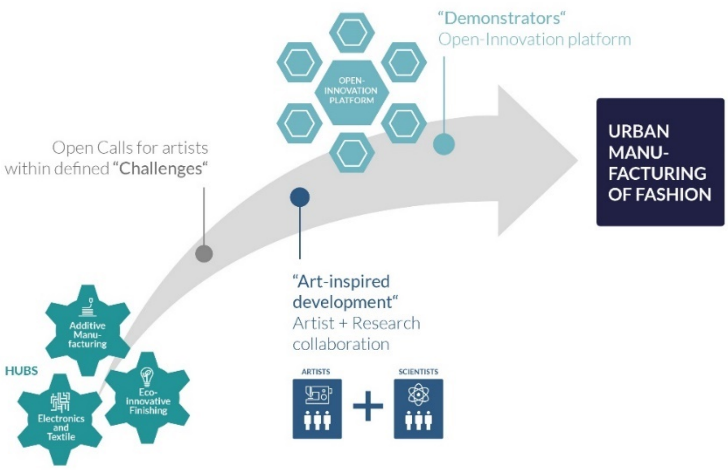
Project co-funded by the European Commission within H2020 Framework Programme		
Dissemination Level		
PU	Public	x
CO	Confidential, only for members of the consortium (including the Commission Services)	
Type		
R	Document, report (excluding the periodic and final reports)	x
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, etc.	

Contents

0 Context Information

0.1 The Re-FREAM Project

Re-FREAM will support **art-driven innovation** in European R&I projects by inclusion of artists in research consortia via linked third-parties. The artistic community receives a strong support from art-related partners like the Art University of Linz (UFG) and the European Institute of Design (IED), creative hubs and facilitators like Wear-IT Berlin (FashionTech), AITEX, ARCA and Creative Region combined with remarkable technology from IZM Fraunhofer (E-textiles), Stratasys, Haratech (3D-printing), EMPA (3D body simulation), Care applications (Garement nebulization) and Profactor (Additive manufacturing).



Re-FREAM boosts **art-inspired urban manufacturing**, where the city becomes a new production space. Especially for **creative fashion**, urban manufacturing offers a great opportunity to create an alternative to the much criticized production in low-wage countries.

Three technologies (additive manufacturing, electronics on textiles and eco-innovative finishing of fashion) will be explored together. **In co-creation** 20 awarded Artist/ Researcher teams, digitalized manufacturing of fashion will be developed up to TRL 5 to enable small-scale production of fashion in urban environment. An **Open-Innovation Platform** will finally link the know-how and the communities of the hubs, will offer access to relevant facilities and make the Re-FREAM art-inspired urban manufacturing working model sustainable.

0.2 Document history

Version	Date	Who	Change/Reason for change
V1	02.11.2020	PRO	Draft template prepared and sent
V2	17.11.2020	AIT	Draft provided to PRO for review
V3	18.11.2020	PRO	Review done by PRO, requesting changes from AIT
V4	21.11.2020	AIT	Draft provided to PRO for review
V5	14.12.2020	PRO, CRE	Final review and coordinator finalization. Submission to participant portal

0.3 Purpose and Scope of Deliverable Report D6.3

Roadmap for each specific textile/non-textile fashion good, in order to provide useful information to further end-users of laser technology about how a specific good must be processed by laser technology.

1 Introduction

The textile industry has seen numerous changes since its inception, the integration of new technologies in recent years has made advances in finishing and processing of materials give very innovative results about quality of materials and in environmental impact reduction of production processes. The inclusion of laser technology has allowed an endless number of applications, leaving designer to expand the possibilities in the new collections.

Now a days, the laser technology is be able to offer cut and semi cut solution to pattern and decor many kinds of different textile materials and leather and in order to design and transfer any kind of image or design, previously prepared with software design, on the surface of the material. The use of the CO2 laser is beneficial in terms of design quality as well as in terms of the company's resources. All desired designs can be achieved, with millimetric precision, by applying the very vast and efficient laser marking processes on the fabric. The energy efficiency and the running speed of a modern CO2 laser source are superior to any other traditional production technique, resulting in a significant decrease of energetic resources. Furthermore, the technology solely modifies the surface of the material - this means that there is no need for water consumption or polluting chemicals.

Today, the largest application of the laser technology for fashion applications, is its use in denim industry, as replacement of conventional dry processes like sand blasting, hand sanding, destroying, and grinding etc. In these cases, the laser solution provides the reduction of risks to workers' health as well as provides a lower environmental impact of industrial production. The advent of laser technology in textiles industry has established a new innovative solution, capable of bringing new fashion effects in several types of materials such as cellulosic fibres, synthetic textile, nonwoven, and synthetic and natural leathers, however, the possibilities of application and expansion of this technology in production processes on a world scale is not complete yet.

This report describes the systems and ways of implementing laser marking and engraving.

1.1 Technical principles

Laser setups used at AITEX can reproduce and transfer all the images that designer can prepare in different design programs, such as CorelDraw, Photoshop and Adobe Illustrator, among others to different kind of substrates. The obtained effects depend on the type of fibres used, as well as on the type of colorants used in dyeing operation.

In Table 1 and Table 2 below, the different effects on materials of laser marking are summarized.

Table 1: Effect by laser marking on colouring materials

Colouring material	Main effect to be achieved by laser marking
Direct dye	Sublimation of the dye, colour removal.
Reactive dye	
Disperse dye	Potential sublimation of the dye. Intensity of the colour will change due to the melting / plastification effect of the polyester caused by the laser marking process.
Cationic dye	
Acid dye	Potential sublimation of the dye. Intensity of the colour will change due to the melting / plastification effect of the polyamide caused by the laser marking process. On wool, sublimation of the dye, colour removal.
Indanthren (Vat dye)	Sublimation of the dye, colour removal.
Indigo dye	

Pigments	Pigments mixed with a binder could be fixed on the fabric surface by a laser marking process. Laser will act as a heat source, in order to 'melt' the synthetic binder.
Metallic pigments	

Table 2: Expected effects and performance of laser marking on material types

Material type	Characteristic	Effects and expected performance of laser marking
Natural or synthetic leather and skin	To be dyed to produce colour effects when laser-marked	Colour effects on the surface Protein-based raw material will carbonize and will generate some ash. Textures and volumes Cutting, holing and pinholing is possible.
3D fabrics	Natural-based	Ablation effect (if controlled) shouldn't generate negative effects or reduction on the breaking strength or on the elastic recovery of the material. Sublimation of the dye, colour removal.
	Synthetic-based	Colour effects on the surface as well as textures. The synthetic material will change its crystallinity performance on the marked surface. Mechanical changes possible. Intensity of the colour will change due to the melting / plastification effect of the synthetic fibre caused by the laser marking process. An excess of power will burn or melt the synthetic material.
Footwear (leather-based)	Material to be marked already confectioned.	Colour effects on the surface as well as textures Protein-based raw material will carbonize and will generate some ash. Expected geometry can change when marking 3D objects with the available CX system, due to the 3D format of the already confectioned object.

1.2 Description of the work system

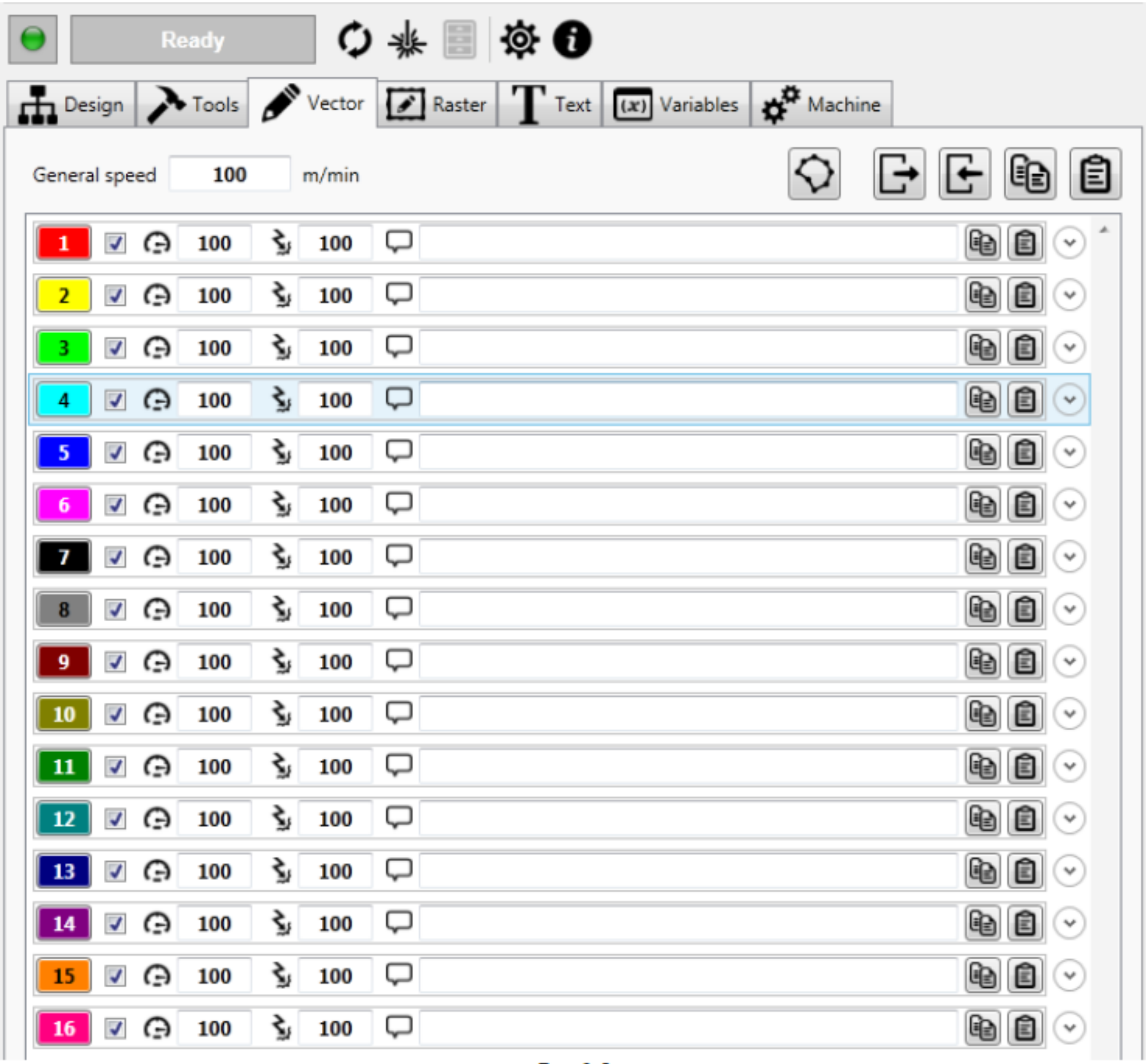
The technology can work with two different methodologies:

- Vectors modes: to reproduce lines, geometric designs, cut and semi-cut works, and
- Raster modes: to reproduce images, logos and ageing effects

The parameters to be programmed according to the work methodology used are provided in detail below in the following chapters. For illustration we use Ot-las plug-in in a CorelDraw software.

1.2.1 Vector methodology

With the “Vector” you can manage all the sixteen vectors you have available as illustrated in Figure 1.



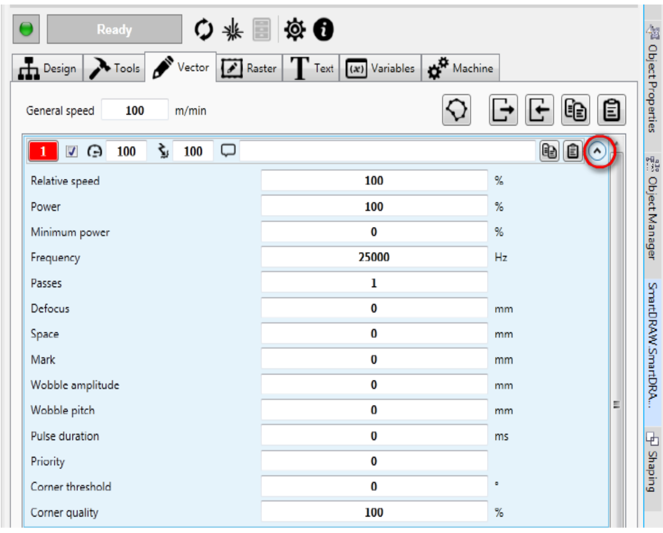
Pic. 2.5

Figure 1: Menu to manage vector settings. For all the pens , the number and the color of the pen is displayed, then the tick that switch on or off the pen, the quick settings, the relative speed (percent of the general speed) and the power of that pen, a blank space where you can write a note, the copy and paste buttons.

Clicking on the little arrow on the right of each pen you open the settings of each pen as summarized below in Table 3.

Table 3: Overview on setting possibilities for vector pens within Otlas plug-in in a CorelDrow software

Setting	Description	
Relative speed and power	Same as the quick settings	
Minimum power	minimum power of the laser during the modulation	
Frequency	frequency of laser beam emission	
Passes	how many times to engrave that pen, one over the other	
Defocus	value of defocusing of the laser beam (= 0 for the thinnest engraving line; ≠ 0 for thicker engraving line)	
Space and mark	engrave the continuous engraving line in hatch line (space=distance between worked line; mark=length of engraving line)	
Wobble amplitude and wobble pitch	it engraves the continuous line as a repetition of little circle	
Pulse duration	duration of the pulse engraving dots	
Priority	Priority of the pen (0 the line will be engraved as first, 1 the line will be engraved as second....)	
Corner threshold	threshold for corners	
Corner quality	quality of corners	



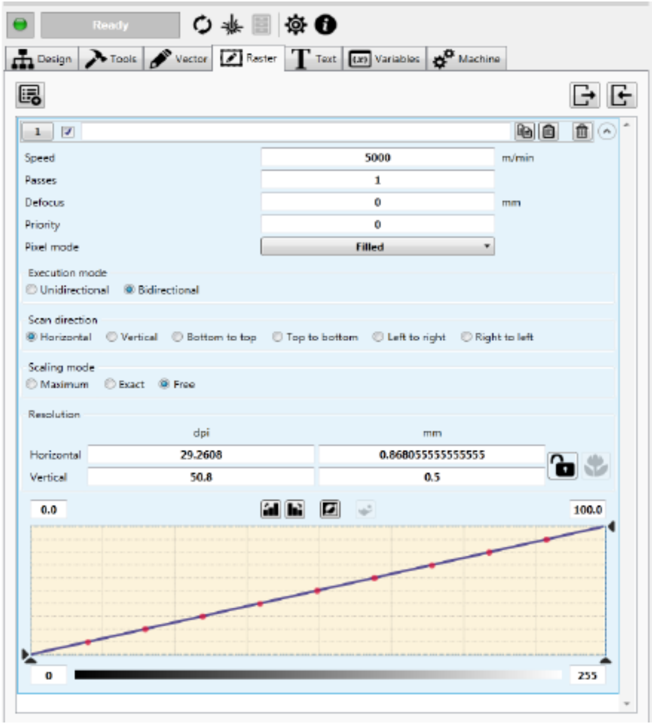
1.2.2 Raster methodology

Clicking on "raster" you have to click on the "Add a raster table" button, to add a raster table. The different setting possibilities are summarized below in Table 4

Table 4: Overview on setting possibilities for raster possibility within Otlas plug-in in a CorelDrow software

Setting	Description	
Speed	scanning speed of the mirrors and determines the accuracy of the pattern and the production capability	
Passes	how many times you want to engrave that table	
Defocus	value of defocusing of the laser	

Priority	priority of that table
Pixel mode	
- **Filled**	normally set on
- **Single pulse**	normally set off
Execution mode	
- **Unidirectional**	the engraving of every line starts on the left and ends on the right
- **Bidirectional**	the engraving line start on the left, ends on the right; the next one starts on the right and ends on the left
Scan direction	direction of scanning of the laser
Scaling mode	
- **Maximum**	Setting speed for calculating the maximum resolution
- **Exact**	Setting resolution for calculating the maximum speed it can do
- **Free**	Setting either speed and/or resolution
Resolution	tuning the horizontal and vertical resolution (in dpi and mm)



The last part of the setting table is the modulation of the laser in relation of the shade of grey. In the diagram depicted above in Table 4, the laser will run at 100% of its power to the white and the 0% of power to the black colour depiction. The correspondence between power and the level of grey can be linear, as it is shown in the example above, or changed point by point (selecting the red points), depending on the BMP pattern and how the material reacts to the laser beam.

1.3 Development of general procedure for working with the laser unit

Below, is described the workflow for the application of laser technology:

1. To choose the material and effect to be achieved with the laser process.
2. Material to be placed inside the cabin of the unit.
    - Material must be placed inside the cabin, to be centred.
    - For flexible materials (fabrics, skin, leather), the sample must be well extended and avoid any wrinkle. For rigid materials (e.g. wood), it must be centred.
    - Cabin door must be closed to avoid any incidence and to provide safe environment for the technicians operating the laser unit.
    - Air extraction working on.
3. For raster design, it is recommended to proceed with a kind of 'grey scale' or to study the suitable power range for marking a specific material.
    - Choose the specific range.
    - Choose the size of the marking zone.
    - Position of the image or graph to be marked must be placed.
    - Power/intensity of each 'grey scale' zone to be set up.
    - Laser marking of the 'grey scale' test.

4. Check the 'quality' and performance achieved with the 'grey scale' test, in order to find the suitable power and intensity of the laser marking process for this specific material.
5. Material to be placed again inside the cabin of the unit.
6. Design to be selected from the library or from the design software.
7. Size of the marking zone to be set up.
8. Y position of the laser unit to be set up.
9. Position of the image or graph to be marked must be placed.
10. Power/intensity of each zone to be marked must be set up. Check the air extraction system is working properly.
11. Laser marking of the material to be done.
12. Check the 'quality' and performance achieved with the laser marking test, in order to find specific defects:
    - Breaking of the fabric when a strength force. An excess of power will produce an excess of ablation effect, and textile fibres will be degraded.
    - Material burns or melts. An excess of power marking / intensity has been set up.
    - Final resolution of definition of the graph is less than expected. Not enough power marking / intensity has been set up; configuration of the marking process in m/min not correct; .bmp laser marking system is selected but not suitable for the specific design to be marked; vector laser marking system is selected but not suitable for the specific design to be marked.
    - Handle of the fabric. Handle and soft touch of the fabric surface decreases due to an excess of power marking / intensity. Plastification of the synthetic fibre surface.
    - Carbonization on natural skin and leather. An excess of power marking / intensity has been set up.

2 Obtained examples

Within this chapter, obtained laser markings are shown, with the application of laser technology over different kind of materials that we considered during the Re-FREAM project as well as via the co-creation projects of the first call. Here, AITEX examples of laser technology applications are shown to also be an inspiration for future Re-FREAMers

In the YouYang Song project we used laser technology to inspire and obtain cutting and design laser pattern on the new eco-sustainability material for different design applications..

In the Fragments Garments project, Elisabeth Jayot, wanted to research the current fast fashion paradigm and use laser technology to cutting of customized spare parts of the garment. This new manually assembled method, would to involve the consumer for dismantle and transform clothes according to changing trends, needs or sizes, thus leading to a longer life-span.

3 Outlook

Other application of laser technology has been investigated by Aitex, in order to improve your knowhow and propose to new options for Re-Fream applicants. Below, you can see the result obtained for different types of textile materials and leathers.

Figure 2: laser marking on cellulosic fibres

Figure 3: laser marking on synthetic fibres

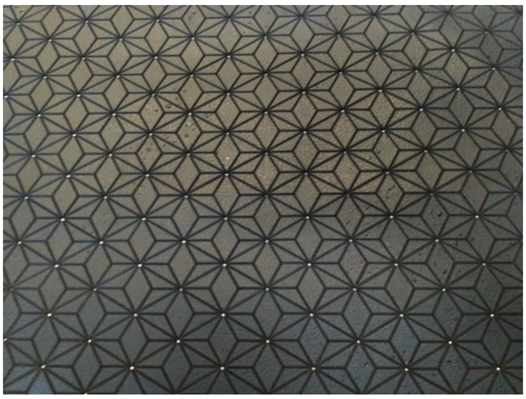


Figure 4: laser marking on synthetic leather (PU)

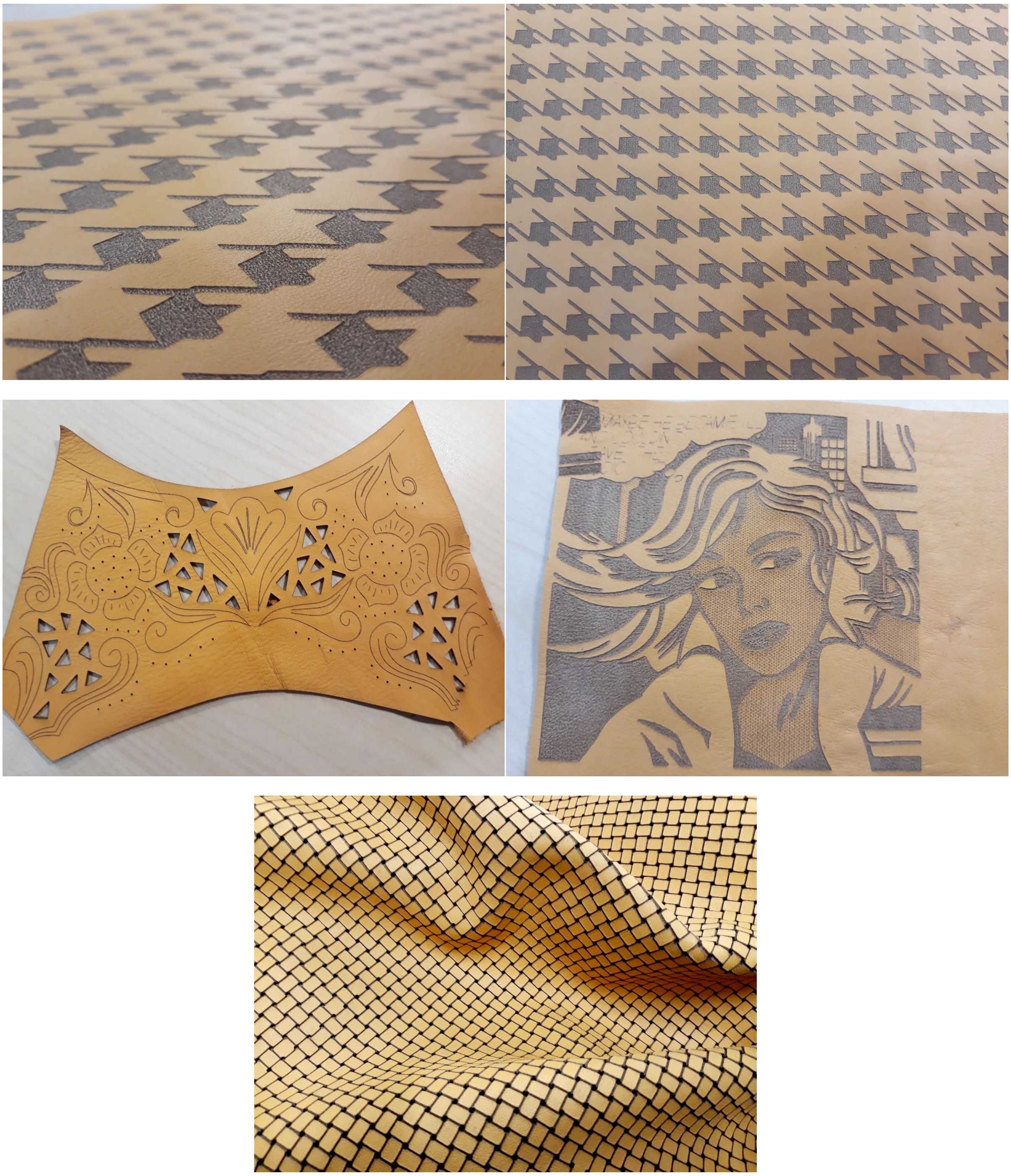


Figure 5: laser marking on leather.