DEVELOPMENT OF A SPECIFIC ELECTROPLATING PROCESS FOR THE MANUFACTURING OF THIN-WALLED HOHLRAUM

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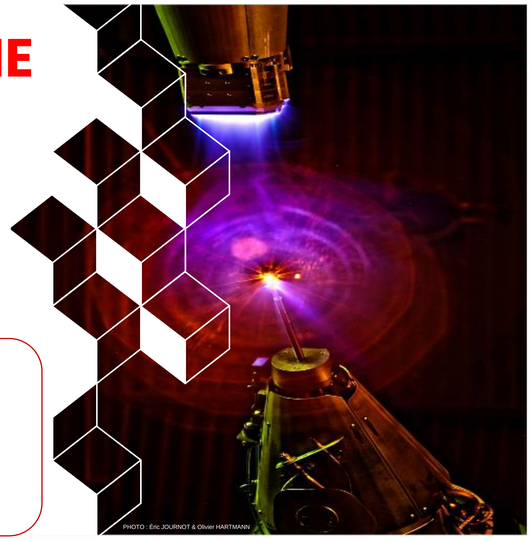
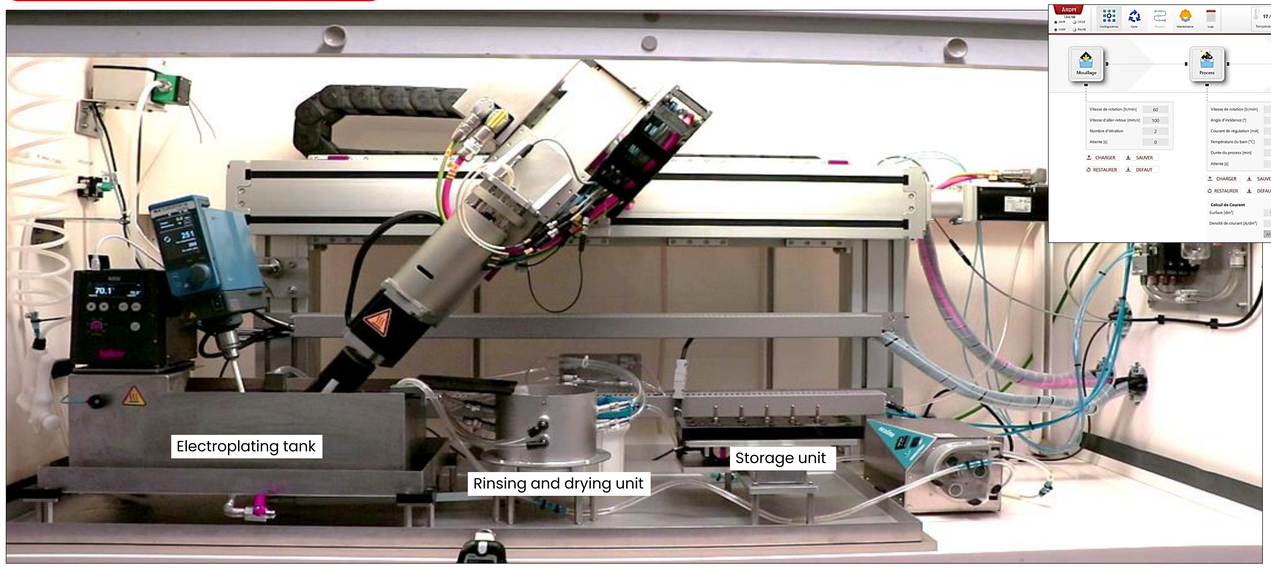


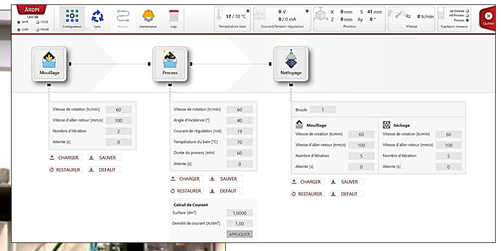
Context

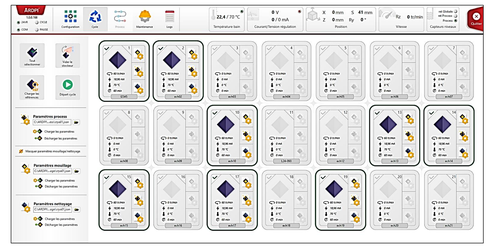
In order to optimize the implosion symmetry for indirect drive experiments carried out on the LMJ facility, the CEA uses a new diagnosis thanks to the development of a hohlraum thin-walled platform. With a gold wall thickness of only 6 µm, the thickness is thick enough to keep the soft X-ray albedo equal to a standard thickness hohlraum, but is thin enough to have good X-ray transmission signal to quantify the laser power of internal and external laser beam cones.

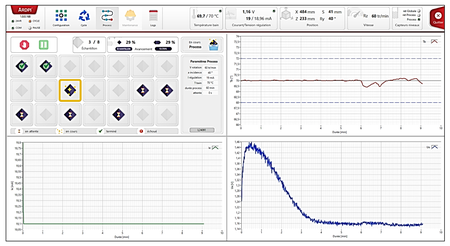
Gold being a very soft material, it is difficult to machine it into a thin layer. This is why a specific process was developed to obtain the desired thin thickness of gold directly by electrolytic deposition. Fully automated and autonomous, the electroplating device guarantees, in a reproducible manner, a wall thickness of a few micrometers with a standard deviation on the thickness of less than 0.5 µm.

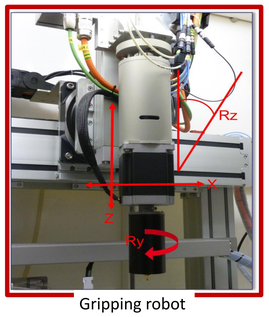
Automated gold electroplating station











Gripping robot

The function of the automated station is to autonomously deposit gold on mandrels to the desired thickness. The parts are placed on a storage unit that can hold 21 parts. For each mandrel, a surface preparation and gold coating program is associated.

Once deposited, the robot rinses and dries the part, returns it to its original location and moves on to the next part.

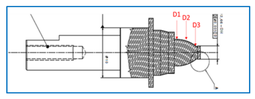
Thanks to a specific software, all parameters (bath temperature, bath level, stirring rate, filtration, etc.) and safety devices are automatically managed .

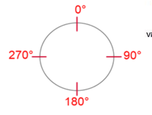
In these conditions, the automated gold plating machine can work 24h/24h without operator intervention.

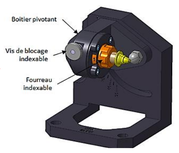
Gold thickness measurement

Mandrel before and after thin gold plating

X-ray fluorescence spectrometer

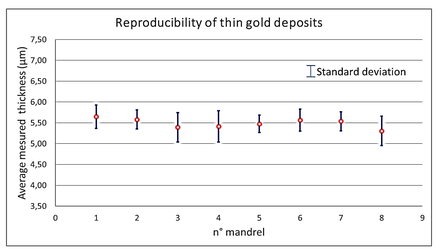






After the gold coating, twelve thickness measurements are carried out on each mandrel by X-ray fluorescence spectrometry with a measurement uncertainty of ± 0,7 µm. For rugby shape hohlraums, a specific tool with angular indexations has been designed and fabricated to measure the thickness of the gold wall.

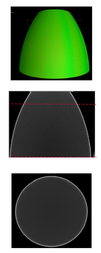
Reproducibility and homogeneity of gold deposits



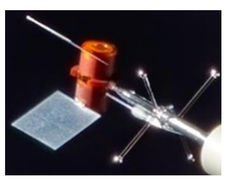
Thanks to a precise and automated control of the electrolysis parameters, the distribution of the current density is optimized and is reproducible from one part to the next.

As the graph shows, the targeted gold thickness of 5.5 µm is achieved for each part.

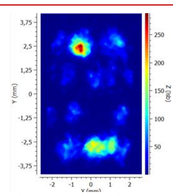
The standard deviation measured on the deposited thicknesses is less than 0.5 µm guaranteeing a uniform thickness of thin-walled hohlraums as also confirmed by the x-ray images.



A new LMJ diagnosis



Thin-walled laser target



Experimental image of laser spots

The control and the homogeneity of these thin gold thicknesses make it now possible on the LMJ, to image the imprint of laser spots over the entire surface of the wall hohlraum, providing an access to crucial experimental data.

Conclusions and prospects

Thanks to this new process, thin gold walls are now obtained and guaranteed directly by electrolytic deposition, eliminating a complex gold machining step. Fully automated and secured, the deposit robot allows parts to be processed continuously without a specific intervention from an operator.

Soon, improvements are planned such as the monitoring and the adjustment of more electrochemical parameters (pH, conductivity, gold concentration, etc.) and a consideration is underway to develop an automated thickness measurement process by X-ray fluorescence spectrometry.

25th Target Fabrication Specialists Meeting – San Diego, CA. August 25th – 29th, 2024