# Development of a web application for estimate the total charge in an electric discharge



# Development of a web application for estimate the total charge in an electric discharge

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**Abstract.** This research seeks to implement a web application to estimate the total charge in an electric discharge from the experimental parameters established in reactors such as the JUPITER-MOSMET [1-5], used to perform surface modifications of metallic and nonmetallic species in solids substrates by hybrid discharges pulsed of high voltage and electric arc at low pressures [6-13]. Estimate the total charge generated in an electric discharge will allow to know the approximate value of the dose of ions implanted in the material surface [14-15], which are of great importance in each one of the experiments performed in the plasma laboratory of the Universidad Industrial de Santander (UIS), where the reactor is installed. Currently there are no applications developed to ease the process optimization and estimate the total charge generated in a pulsed electric discharge.

## 1. Introduction

The Laboratory of Plasma of the Research Group in Physics, Plasma and Technology and Corrosion (FITEK) adjoint to the school of Physics at the Universidad Industrial de Santander (UIS) in conjunction with the Development Research Groups of Software Engineering (GIDIS) and Ceramic Technology (GITEC) of the Universidad Francisco de Paula Santander, are performing experimental research in the area of surface modification of metallic materials by the three-Dimensional Ion Implantation technique (3DII) [2,3,9,10] generated by hybrid discharges of high voltage and electric arc at low pressures [6-13]. The Ion implantation produces defects in an extension of material volume, which are very difficult to observe directly [16-18]. Most of the superficial characterization experimental techniques employed to measure or observe the defects and the implanted ions concentrations only provide information on the surface, instead of examining the structure below it [19], where the ion amount and types of defects produced are of importance in the analysis of changes in the surface properties of the treated material [16-19].

For researchers in the area of surperficial modification, especially the one performed by electric discharges of high voltage at low pressures [6-13], it is very important to characterize the estimation of the total charge and the implanted particles in metallic solids as a function of depthness, moreover, there is a need to understand the complex phenomena that occur during the process. Therefore, the development of a web application and a computer simulation are of great importance, especially because we can obtain information that today could not be obtained by other means. That is why it is necessary to develop computational tools that estimate more quickly, accurately and precisely the total charge generated in an electric discharge and the ion concentration implanted in metallic materials.

## 2. Experiment methodology

In Figure 1 is present the three phases executed according to the methodological model proposed in the present investigation.

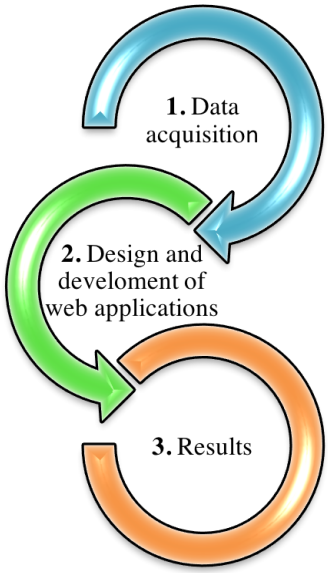


**Figure 1.** Methodological model.

### *2.1. Phase 1: Data acquisition*

The data acquisition (current pulses) was performed from the experimental parameters that were established in a surface modification process (ion implantation) of metal substrates by means of an electric discharge [4,12,13]. The current pulses registered in the electric discharge, represent the total electric charge generated in funsion of the time.

### *2.2. Phase 2: Design and development of web application*

The design and development of web applicative is a computational tool made in order to calculate quickly and accurately the total charge estimated in an electric discharge from the data acquired of a set of current pulses. The obtained data were digitized and graphed in order to calculate the area under the curve representing the total electrical discharge estimated.

### *2.3. Phase 3: Results*

The results of the area under curve estimated (total electric charge estimated) are reported by the web applicative.

## 3. Results

A web application was implemented in order to estimate quickly and accurately the total electrical charge from a pulse of electric current in funsion of the time. Figure 2 shows the use case diagram describes the cua features that the user is available on the web application is presented.

The web application allows the user to upload image files and data in CVS format (see Figure 3) corresponding to the pulse of current that can be captured on an oscilloscope during ignition of the electric discharge (in our case we use the oscilloscope Tektronix TDS 2002 B); where the computational tool performs a process of digitization of data and graphic. After presented the graphic along with the image of the pulse, the user sets the maximum and minimum values that determine the pulse width necessary to calculate the area under the curve and estimate the total electrical charge (see Figure 4).

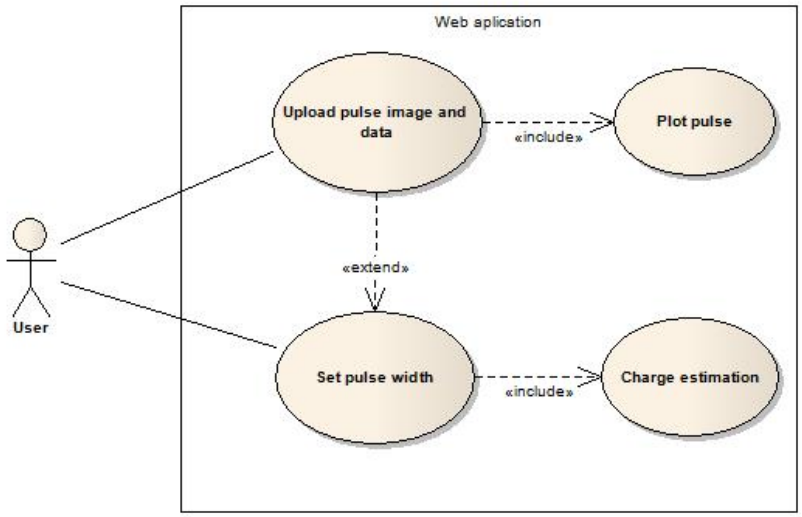


**Figure 2.** Functionalities of the web application.


**Figure 3.** Section to load the image and the pulse data.

In Figure 3 after the data is loaded, it is clicked on process and the system automatically processes the data, the graphics and shows the estimated total charge of the electric current pulse (see Figure 4). At the top of Figure 4 is reported the pulse image obtained of the oscilloscope Tektronix TDS 2002 B and at the bottom the pulse graphed from the web application (as shown in the Figure 4, the graph obtained is very similar the acquired with the oscilloscope).

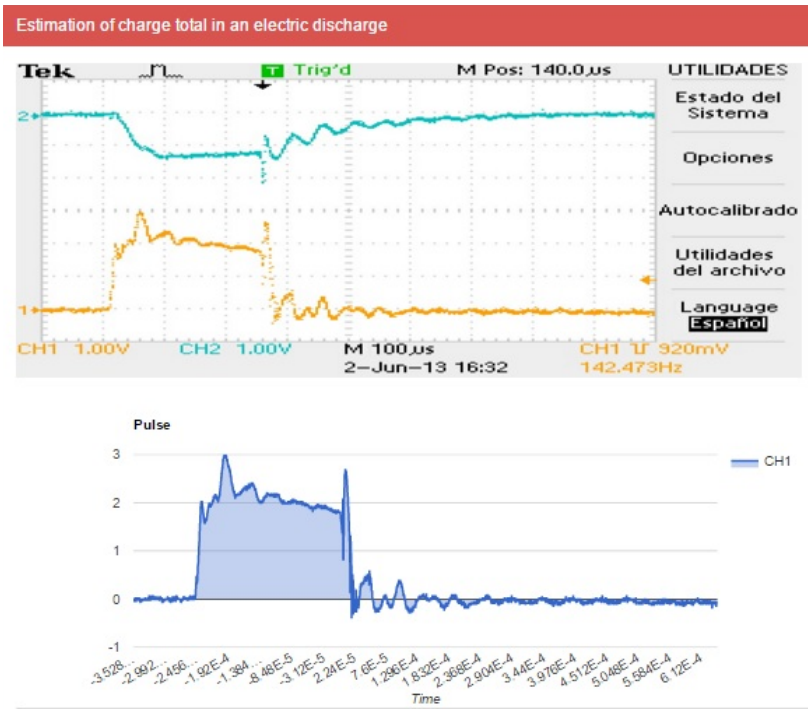


**Figure 4.** Image and graphic of pulse in the web application.

Finally, at the bottom of Figure 5 the estimated calculation of the total charge in the electric discharge is shown.


**Figure 5.** Results of the estimate total charge.

## 4. Conclusions

A computational tool to streamline and estimate the calculation of the total charge generated in a process of surface modification by electric discharge, bringing benefits to experimental researchs in the plasma laboratory of the UIS was built.

The web application developed can be used anywhere, at any time and without any special requirements, just need an Internet connection and the current pulse data to be processed. The format of the data received by the system can be downloaded from the web application.

The processing of data obtained from the web application are very similar to those current pulses reported experimentally during the ignition of the electric discharge, ensuring that the implemented web application works correctly to estimate the total charge.

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