

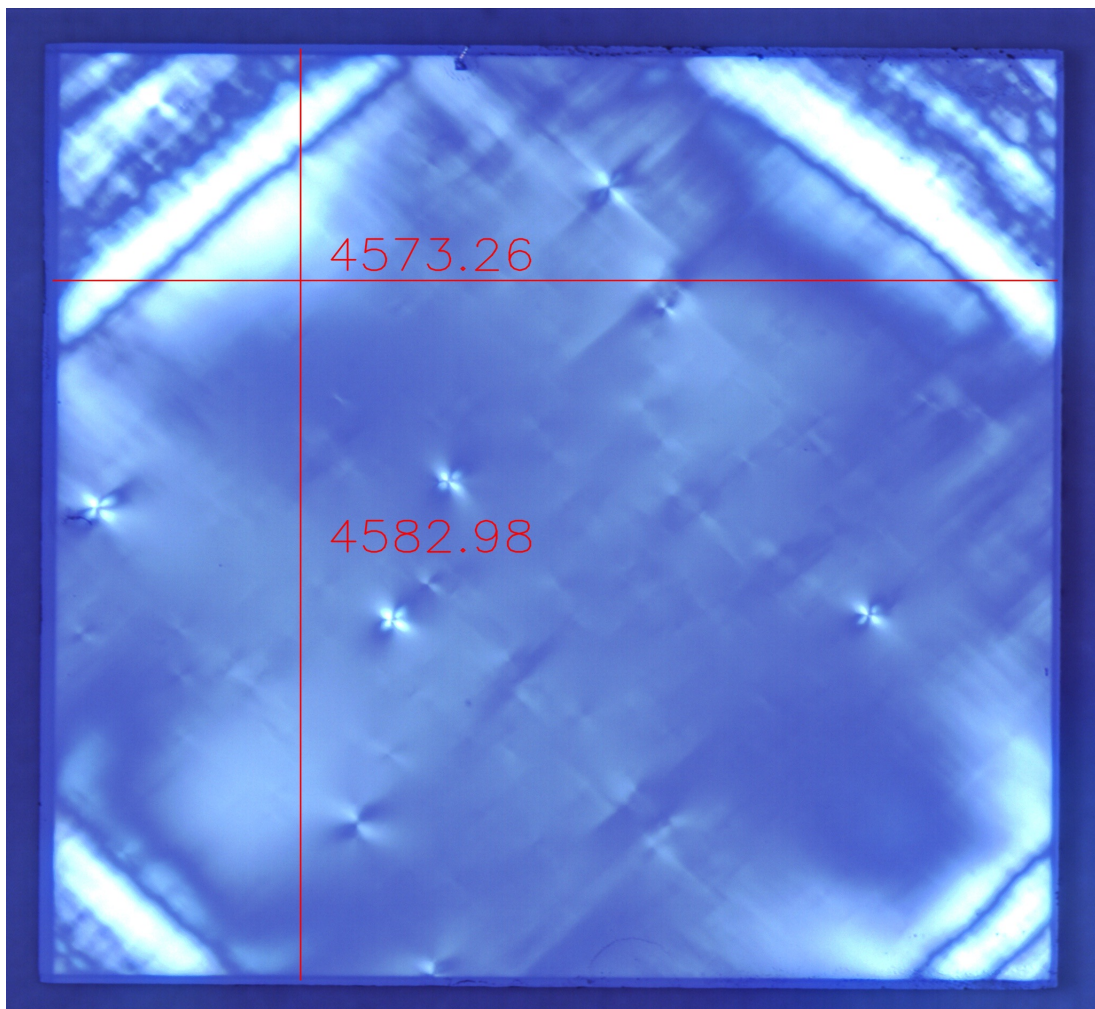
# Characteristics of sCVD Diamond Sensors

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## Abstract

Radiation hard diamond sensors are fundamental for the development of beam diagnostics instrumentation for accelerators. The quality control of diamond sensors is vital to determine the sensor's characteristics for dedicated applications. The optical quality control tells the defect level in the diamond material before metallisation while Transit Current Technique (TCT) is instrumental in understanding the movement of electrons and holes in the diamond sensors and their respective ionisation energies. The IV and It measurement provide the dark current profile of the sensors for DC-based applications. This study presents an overview of characteristics of 45 single-crystal chemical vapour deposition (sCVD) diamond sensors and a selective data analysis of different parameters measured during quality control.

## Diamond Sensors

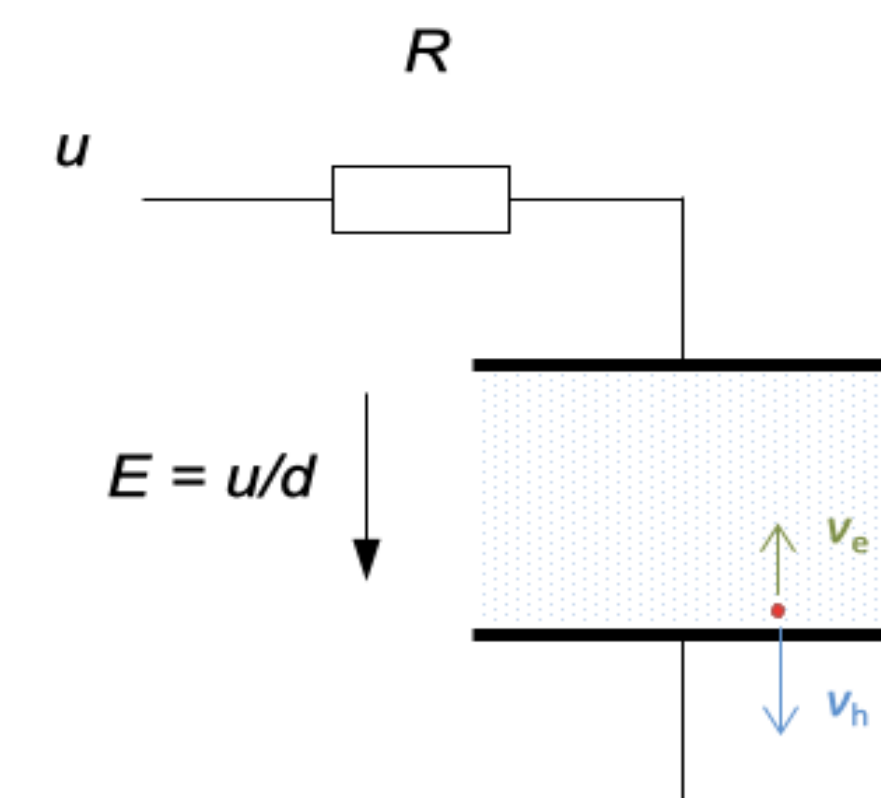


sCVD diamond crystal before metallization.

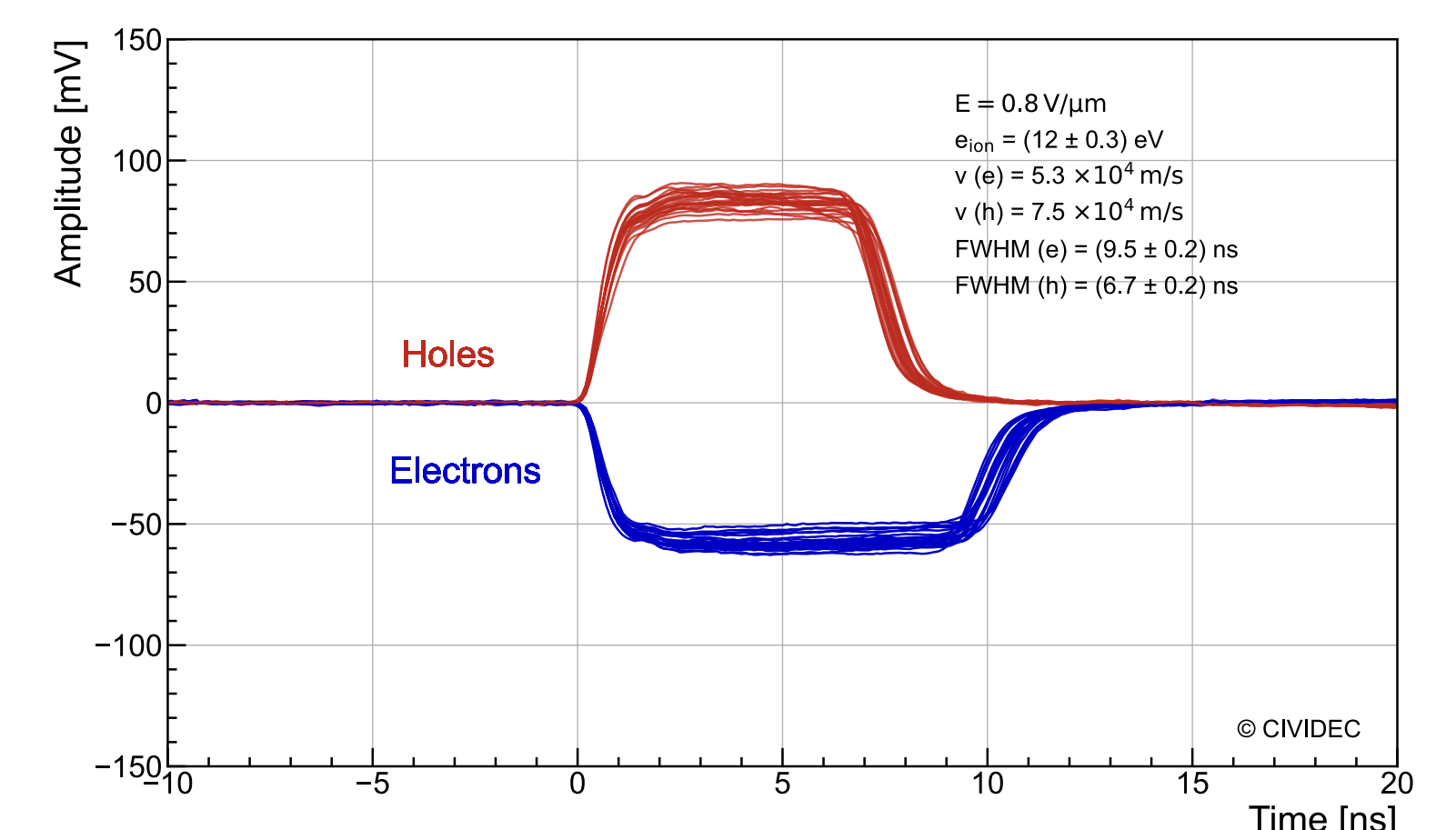


sCVD diamond sensor after metallization.

## TCT Measurements

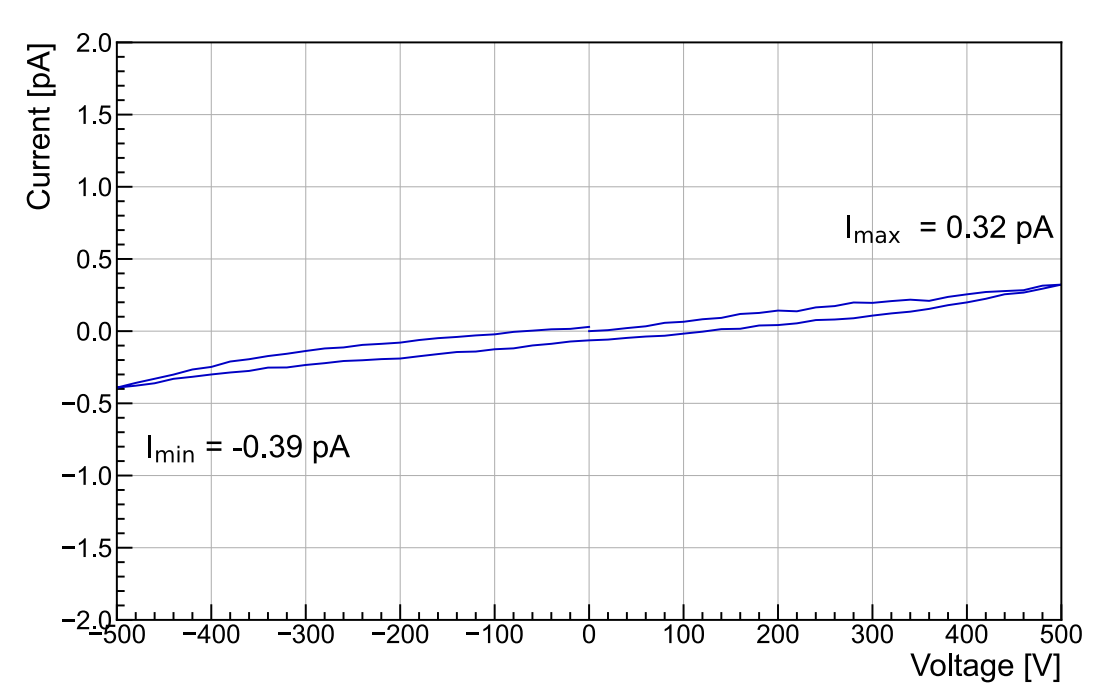


Schematic for the current readout in sCVD sensor.

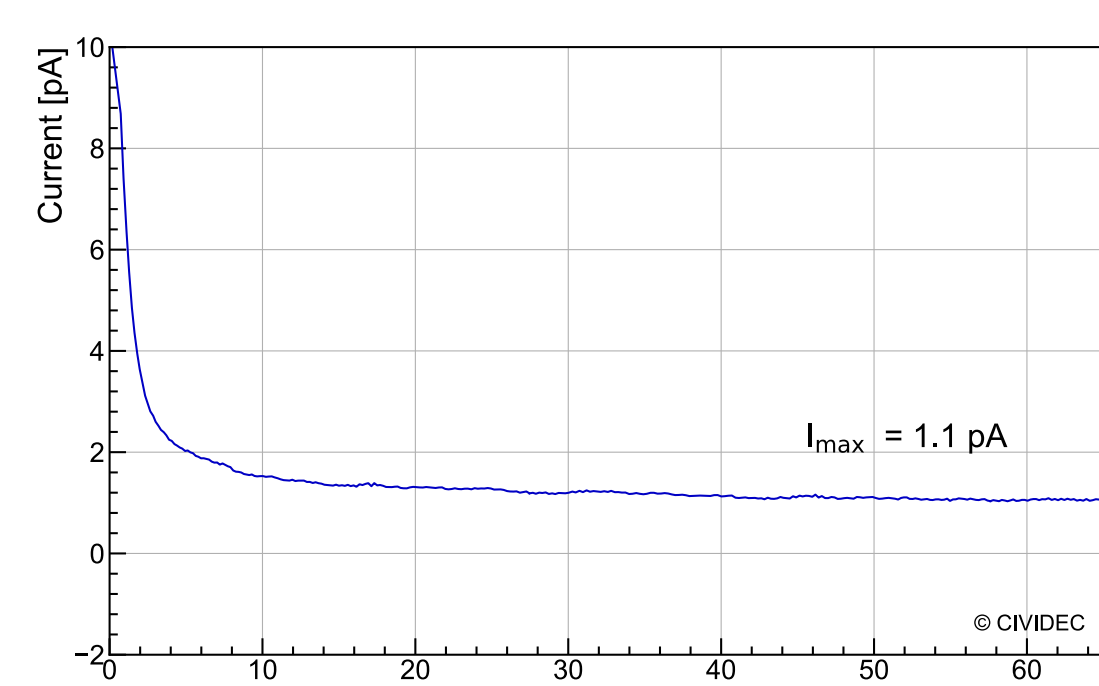


Rectangular pulse shapes measured for  $\alpha$  particles from  $^{241}\text{Am}$  with sCVD sensor.

## Dark Current Measurements

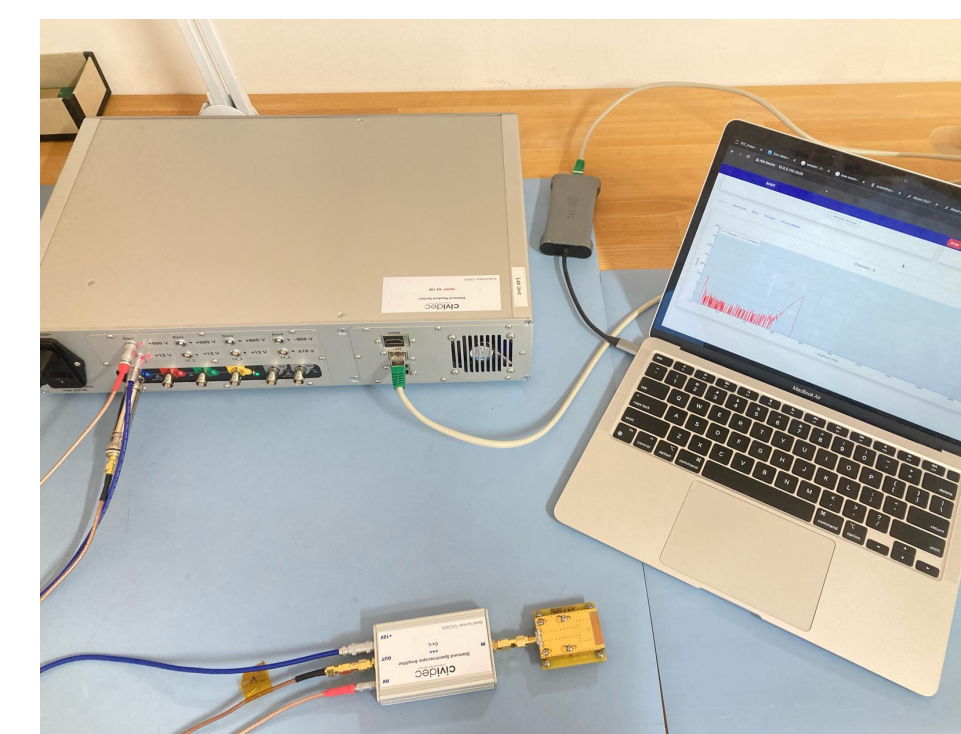


Dark current measurement over an applied voltage of  $\pm 500 \text{ V}$ .

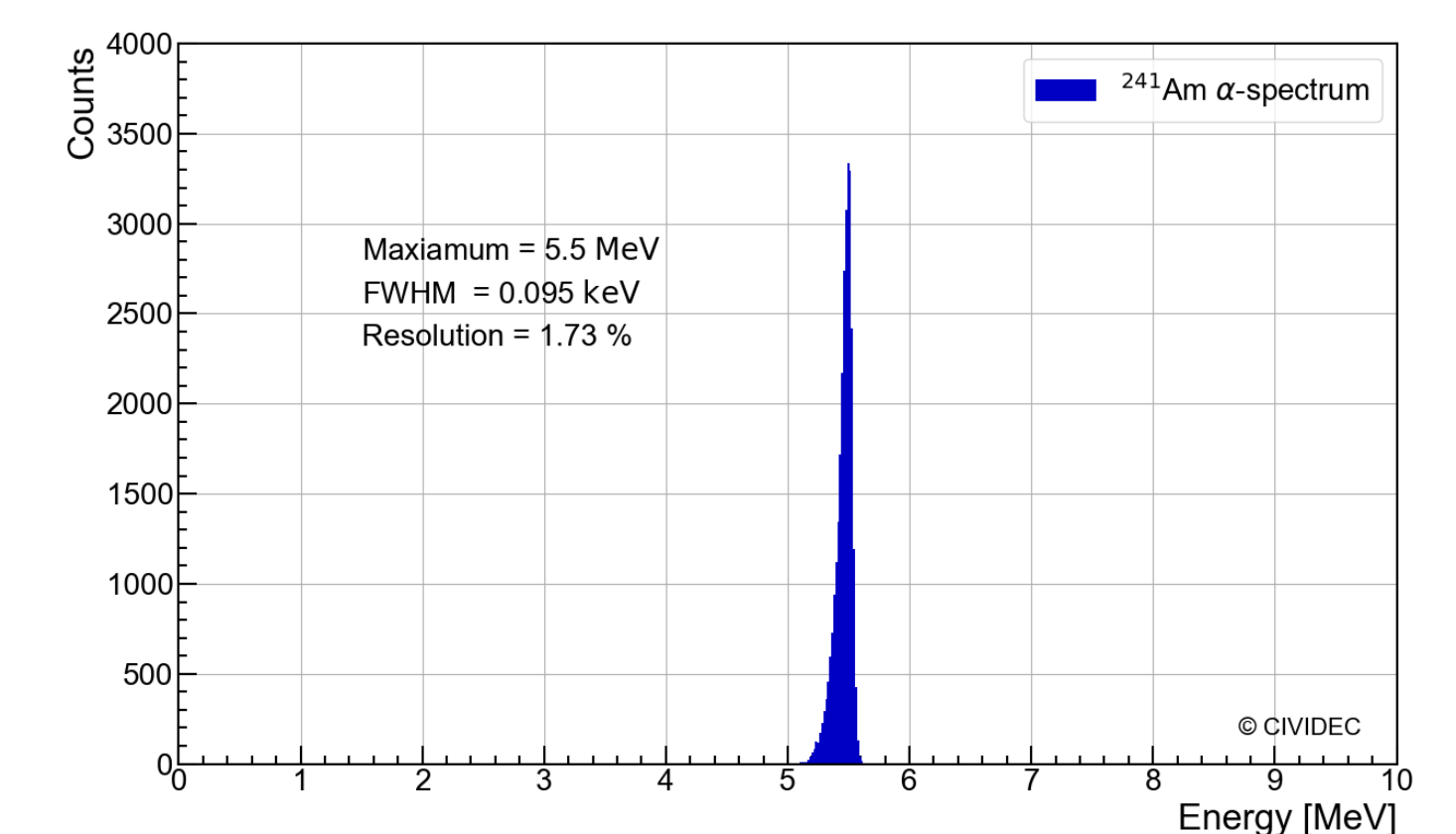


Dark current measurement at  $+300 \text{ V}$  for 60 seconds.

## Alpha Spectroscopy

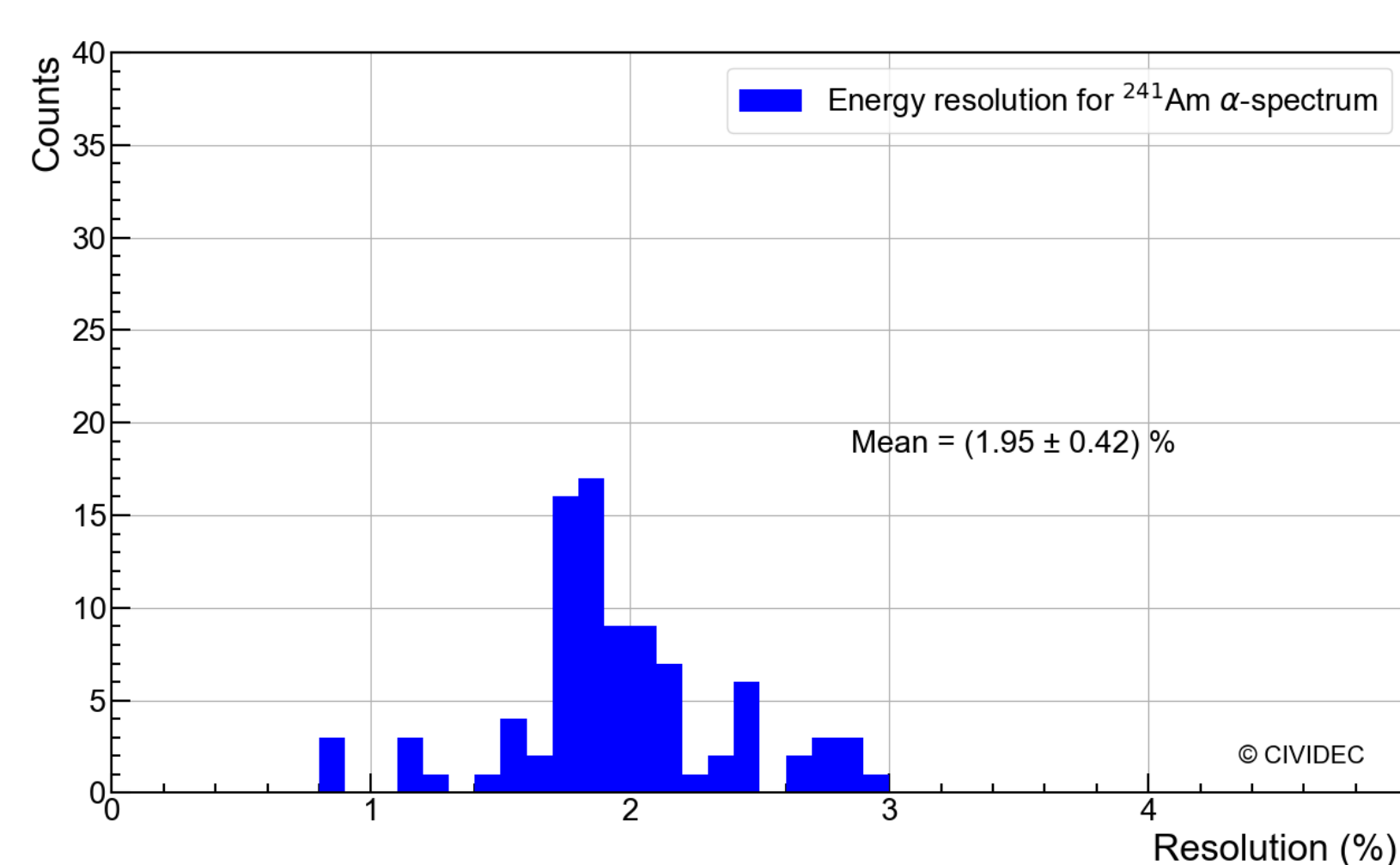


CIVIDEC Alpha spectroscopy setup.

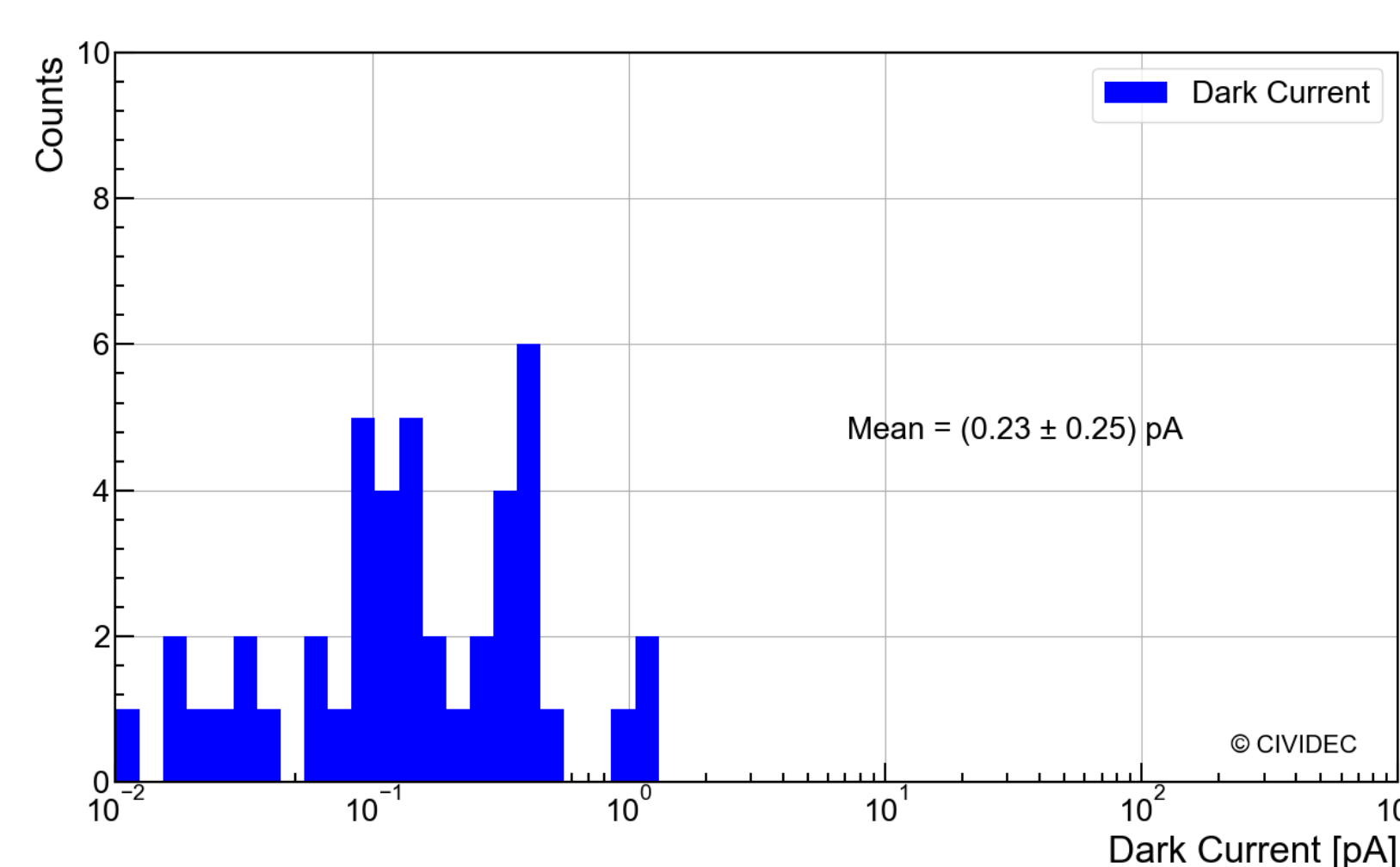


$^{241}\text{Am}$   $\alpha$ -spectrum of sCVD sensor.

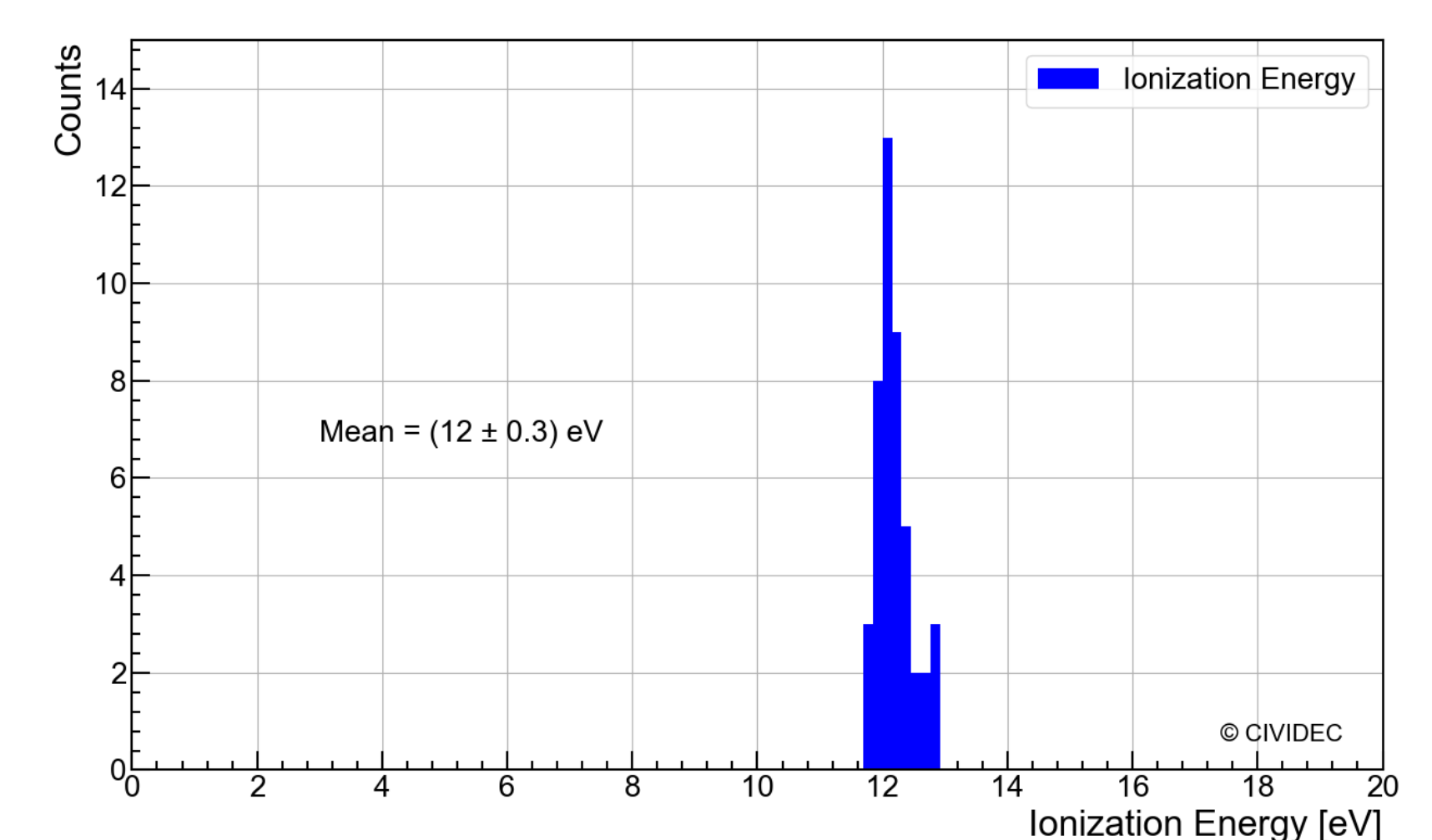
## Statistical Analysis of Characteristics in Calibrated Sensors



Energy resolution statistical distribution of 45 sCVD sensors.



Dark current statistical distribution of 45 sCVD sensors.



Ionization energy statistical distribution of 45 sCVD sensors.

## Conclusion:

The sCVD sensors have an average dimension of  $(4.55 \times 4.59) \text{ mm}^2$  and a thickness of  $523 \text{ }\mu\text{m}$ ,  $(4 \times 4) \text{ mm}^2$  Pt electrodes on both face, each with a thickness of  $100 \text{ nm}$ . The calibrated sCVD sensors consistently demonstrated an average energy resolution of  $1.95 \%$ . Additionally, these sensors exhibited a very low average dark current of  $0.23 \text{ pA}$  at  $+300 \text{ V}$ .

This research project is funded by MSCA-DN within the framework of EuPRAXIA. The research work is conducted at CIVIDEC Instrumentation GmbH, Vienna and supervised by Prof. Erich Griesmayer.

