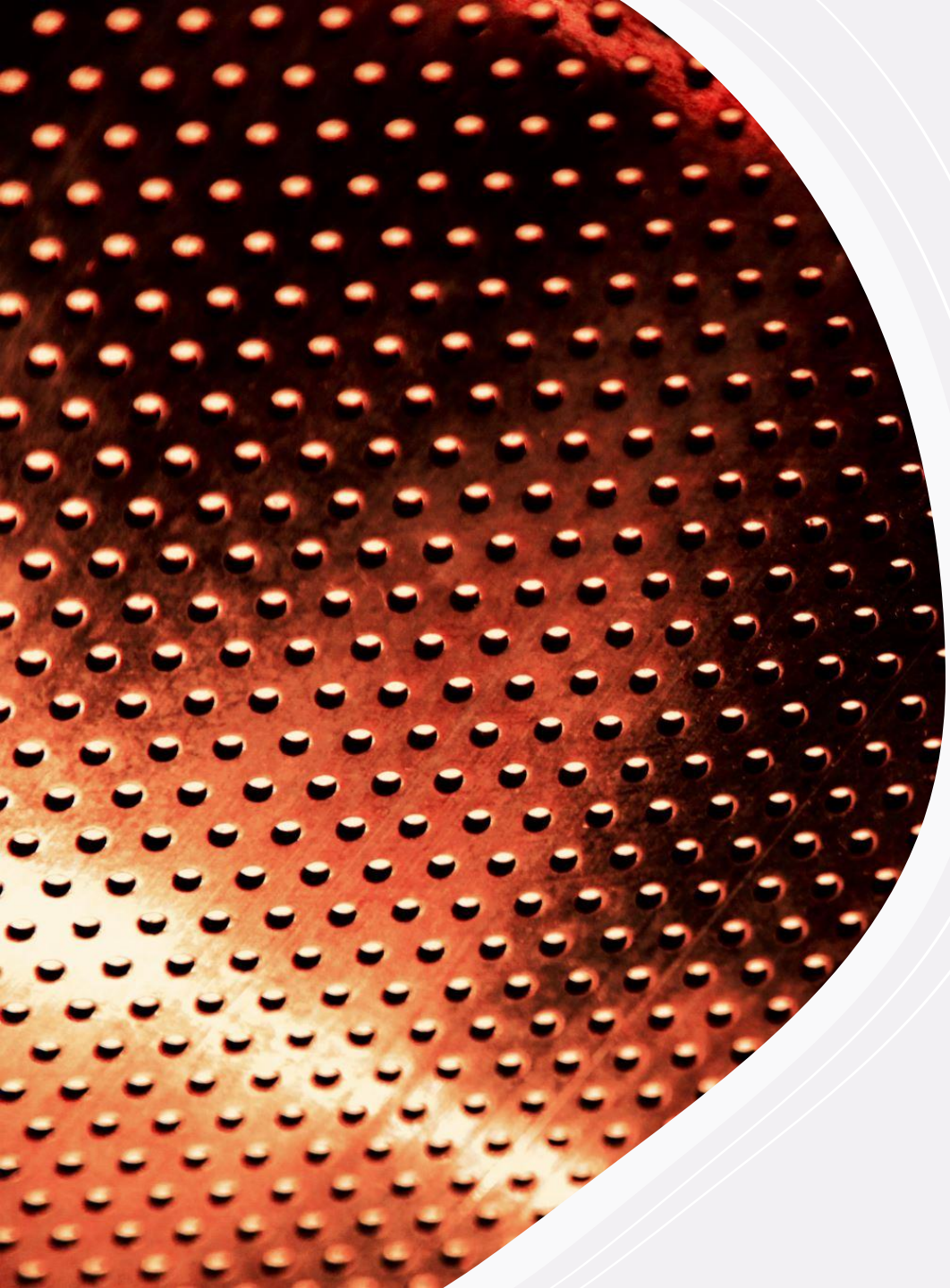


Thermal evaporation of thin layers of Copper for detector development

LIP Internship

Author: André Azevedo

Supervisors: Manuel Xarepe & Pamela Teubig

Resistive Plate Chamber (RPC)

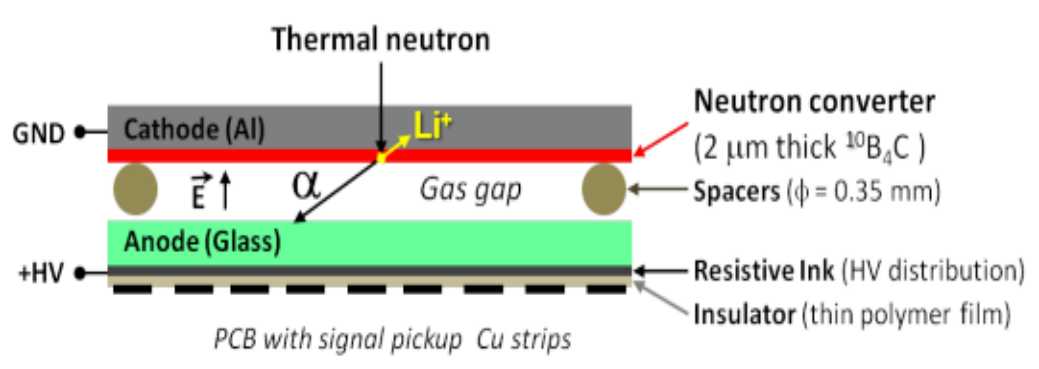


Figure 1-Scheme drawing of a RPC detector [1]

- RPC's are used on subatomic particle detectors
- The electron avalanches are picked up by Cu strips
- The strips must be isolated electrically from each other

Thermal Evaporation

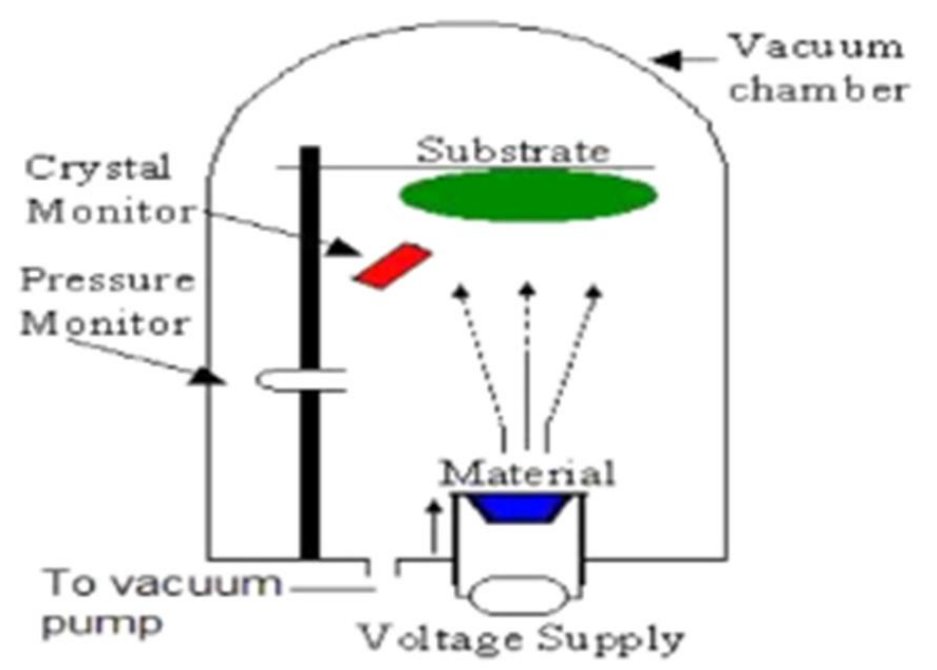
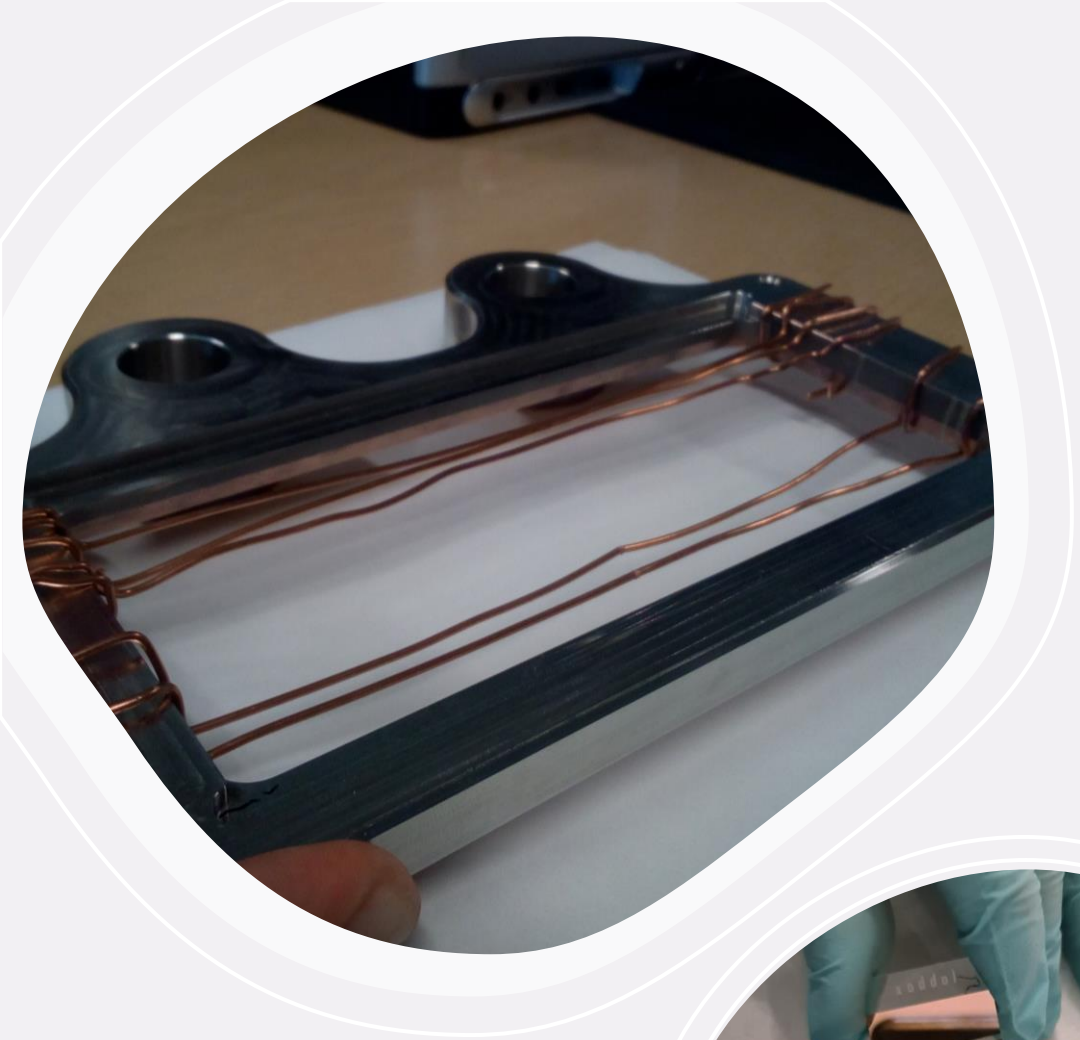
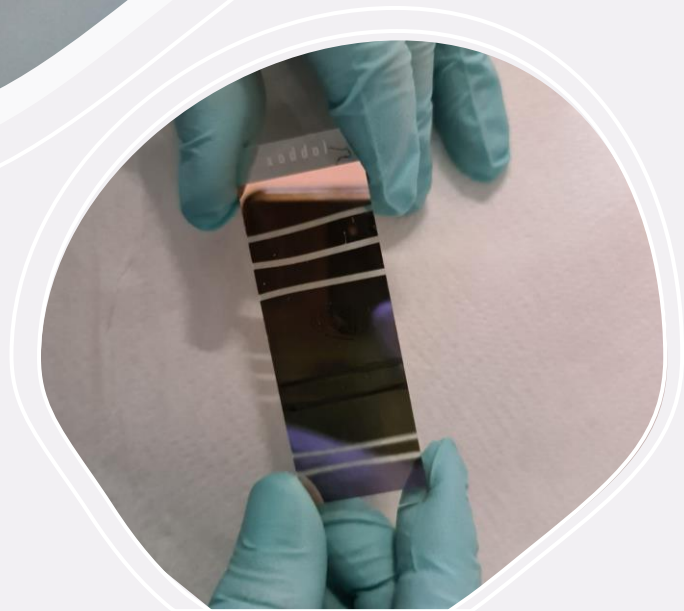


Figure 2-Scheme of the Thermal Evaporation Deposition method [2]

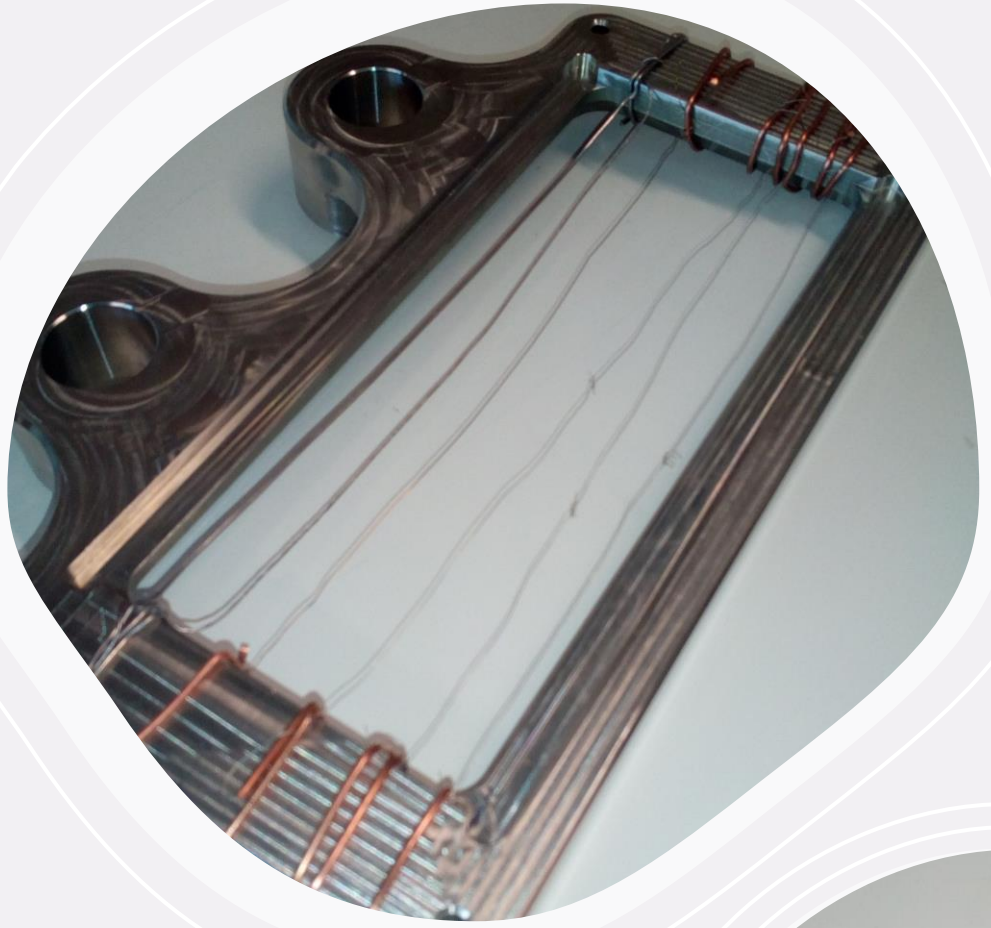
- The vacuum environment reduces Cu’s evaporation temperature
- The melting pot is heated by the resistance of an electrical current
- The vaporized Cu condenses on the substrate’s surface, forming a thin film





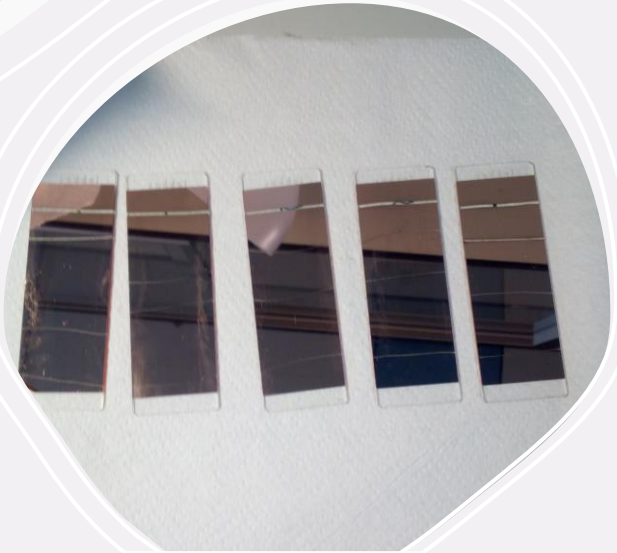
Deposition 1

- Five **0.9 mm** width wires
- Two differente distances of the wires from the substrate: **7.2 mm** and **3.6 mm**
- **Positive result**



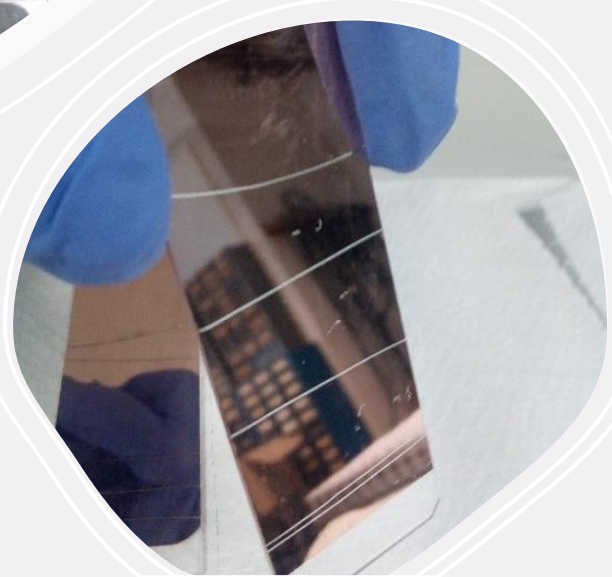
Deposition 2

- Different width wires: **0.9 mm**, **0.4 mm**, **0.25 mm** and **0.2 mm**
- Same distance between wire and substrate
- **Negative result**



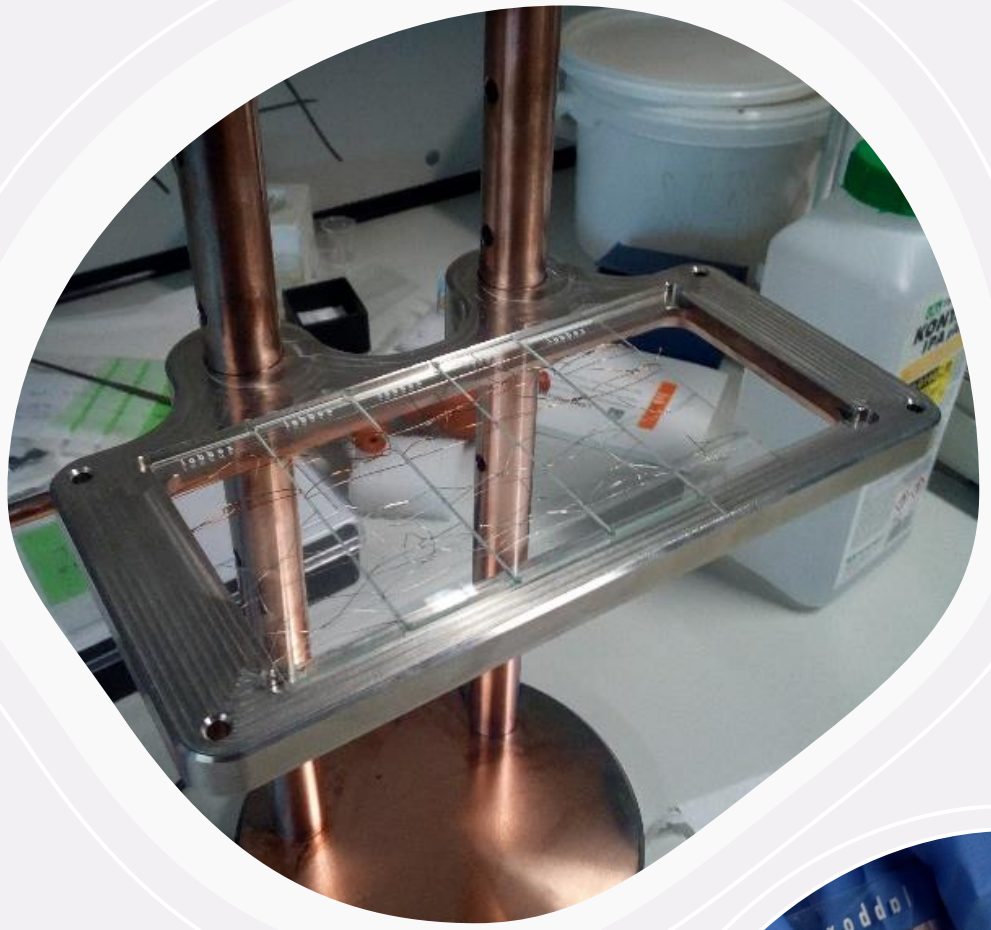
Deposition 3

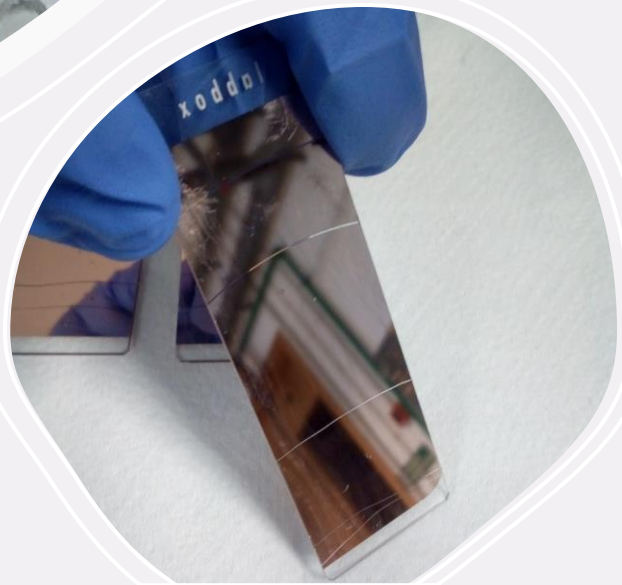
- Individual wire setup: **0.25 mm** and **0.2 mm** width wires. Lower distances between wires and substrate
- One **0.9 mm** width wire along all samples
- **Positive result**



Deposition 4

- Individual **0.25 mm** and **0.2 mm** width wires
- Smallest strip produced: **1.55 mm wide**
- **Positive result**





Deposition 5

- Lower distance between melting pot and substrate
- Individual **0.25 mm** and **0.2 mm** width wires.
- Smallest strip repeated: **1.55 mm wide**
- **Positive result**

Rutherford Backscattering Spectroscopy (RBS)

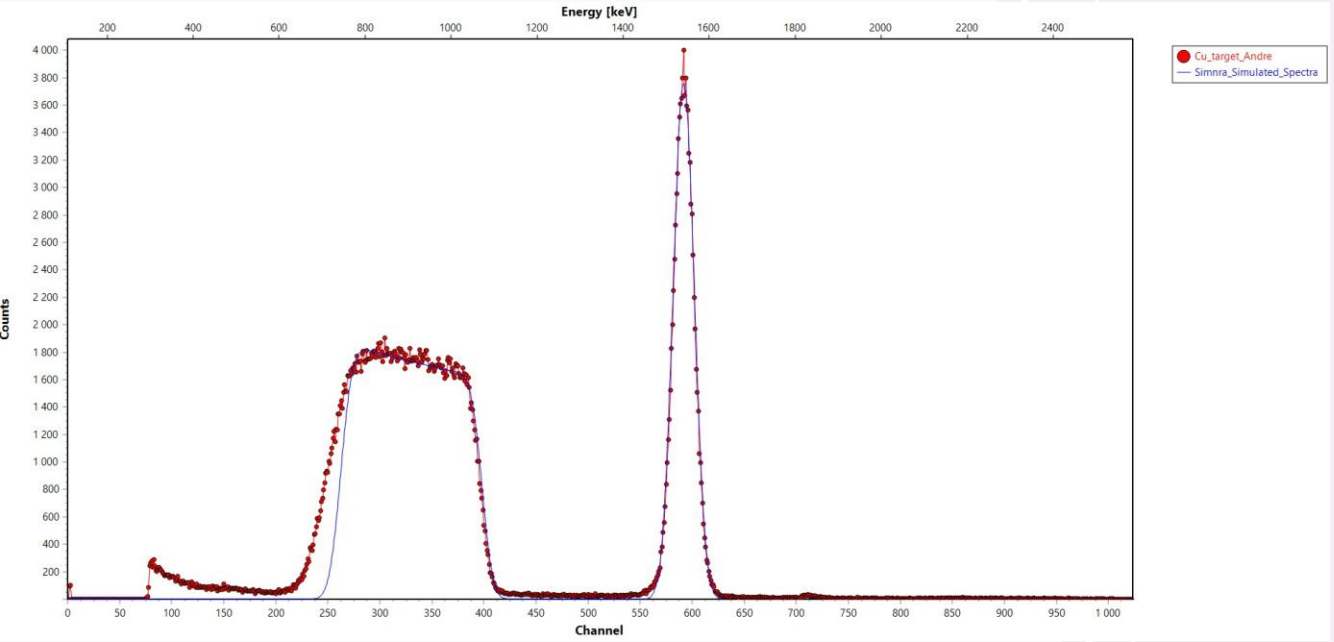


Figure 3 – RBS chart of the sample from deposition 1. Were used alfa particles with 2 MeV and a 160º angle.

- RBS is a non-destructive characterization method
- It can determine the composition and depth of a thin film
- A sample from deposition 1 was measured, being **44 nm in depth**

Final results

Smallest Strip	**1.55 mm**
Smallest Gap	**0.2 mm**
Film Depth	**44 nm**

Biography

[1] A. Morozov, L. M. S. Margato, and I. Stefanescu, “Simulation-based optimization of a multilayer 10B-RPC thermal neutron detector,” *J. Instrum.*, vol. 15, no. 3, Feb. 2020, doi: 10.1088/1748-0221/15/03/p03019.

[2] “Basic deposition methods of thin films** | Elsevier Enhanced Reader.” [Online]. Available: https://reader.elsevier.com/reader/sd/pii/S0022286021007390?token=297D018AE8CA6FF25E7C7CFCC6E121C2522DFC4BA26EFF50100AD0F25E1ADDFC5B7CCC4C0926098B1EB469EA5915A75C&originRegion=eu-west-1&originCreation=20210719094634. [Accessed: 19-Jul-2021].