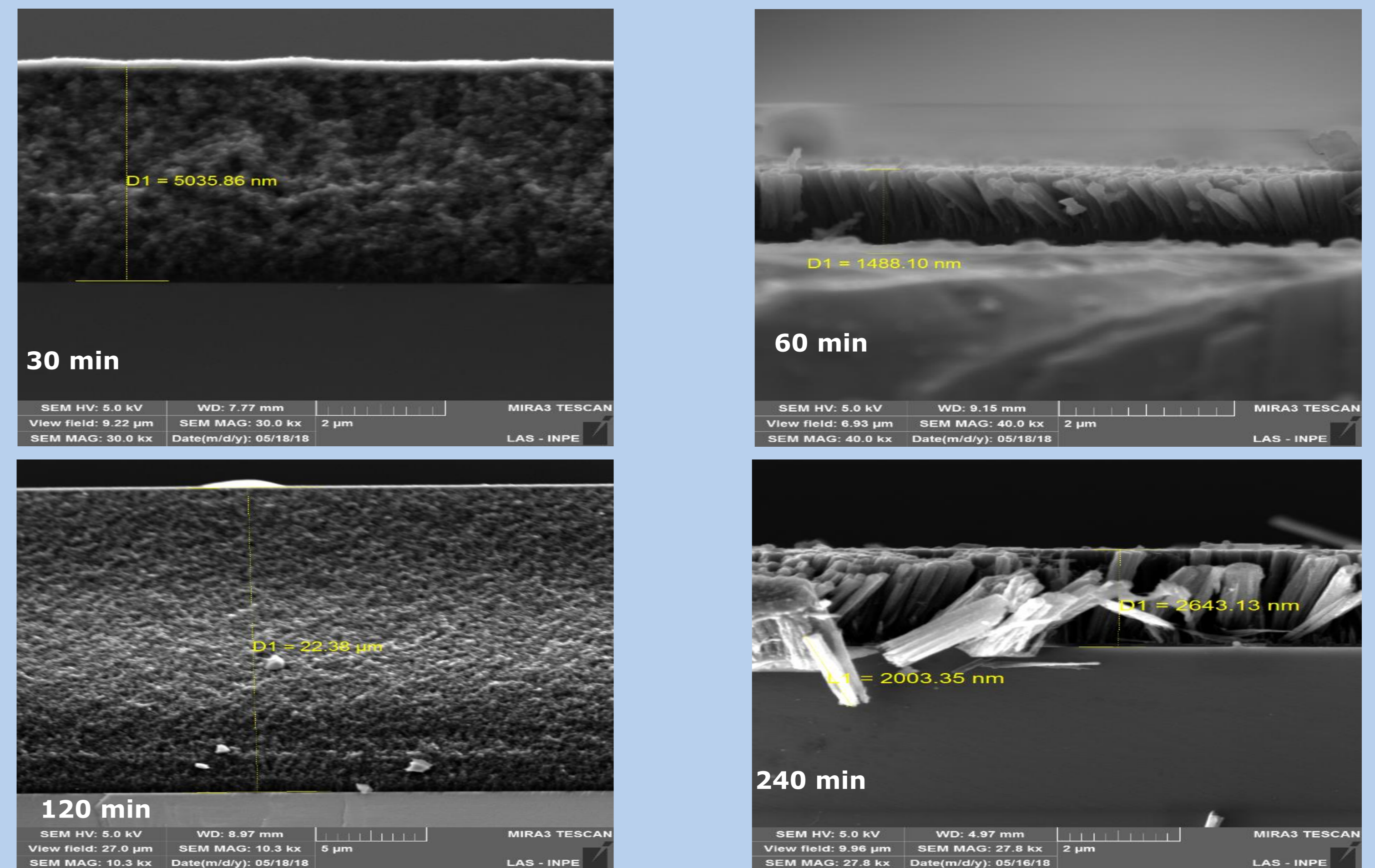


## ABSTRACT

- The purpose of this work is to deposit diamond-like carbon (DLC) films inside titanium alloy (Ti-4Al-6V) tube of small diameter, in order to increase the corrosion resistance.
- Using DLC films as protective coatings can increase the lifetime of the tubes used in propulsion and thermal control systems of satellites and inhibit the permeation of corrosive species from the fuels and the cooling fluids through the film-metal interface.
- Titanium alloy tube with 11 mm diameter and 150 mm length with one side closed configuration was placed inside vacuum chamber and driven by a high voltage pulser.
- DLC film deposition was performed with PIII&D system, driving hollow cathode (HC) discharges using RUP-6 pulser.
- The formed films were analyzed in terms of the microstructure, chemical composition, surface morphology and thickness.
- Such analyses were conducted in different substrates by means of Raman Spectroscopy, Field Emission Gun – Scanning Electron Microscopy (FEG/SEM/EDS), and X-ray Diffraction (XRD).

## RESULTS

### SEM-FEG/EDS



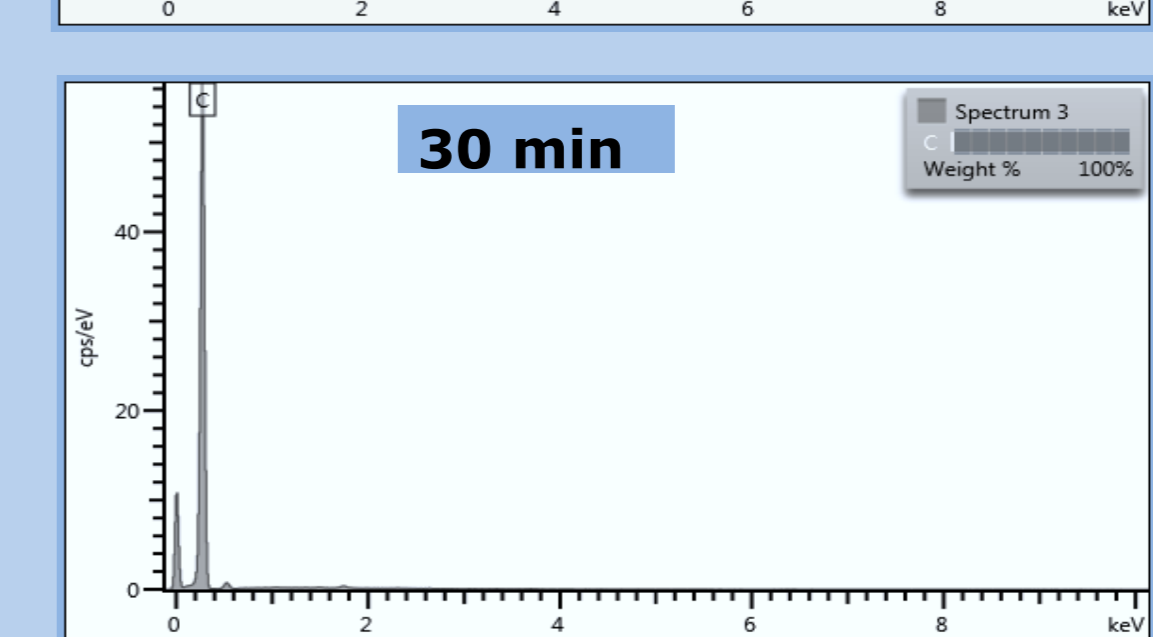
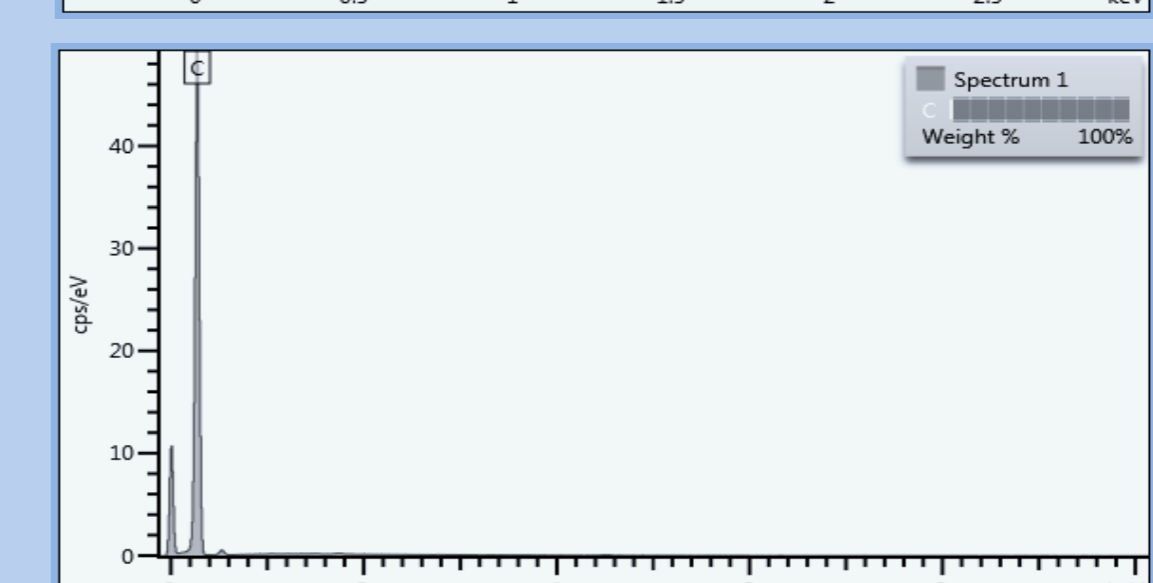
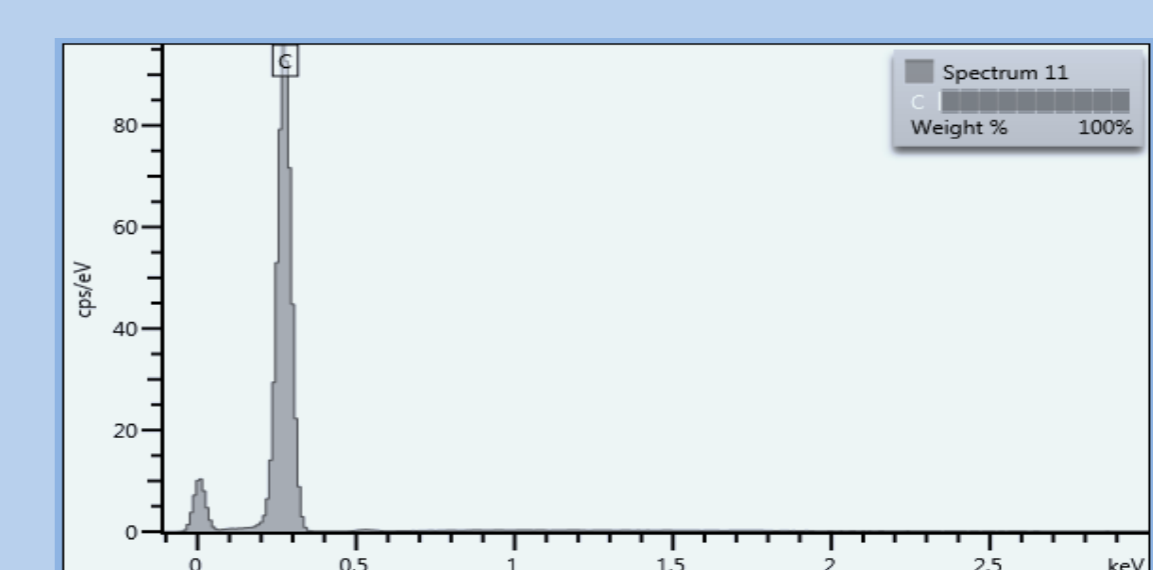
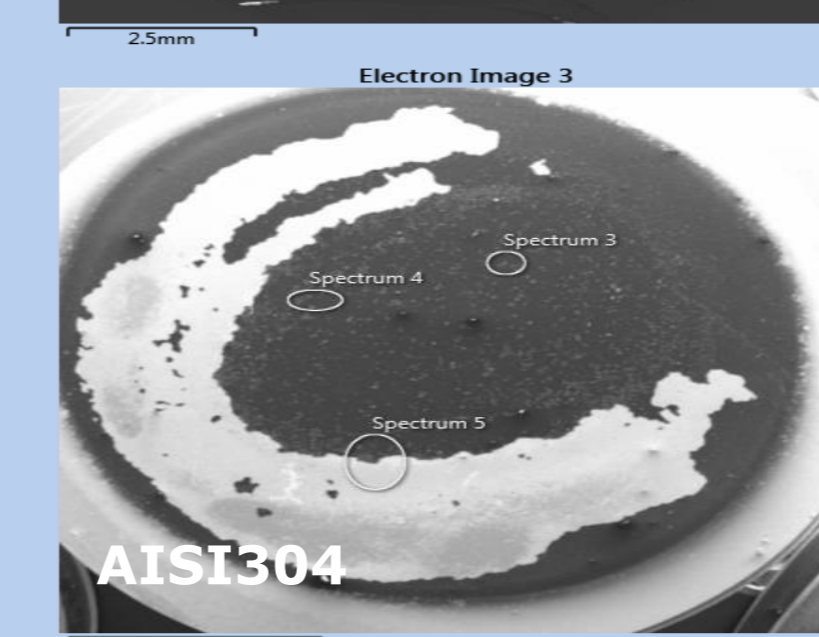
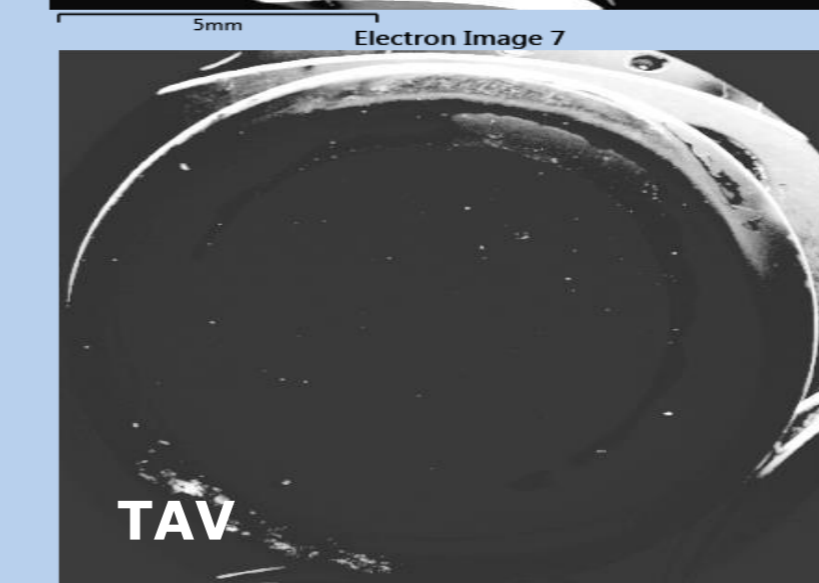
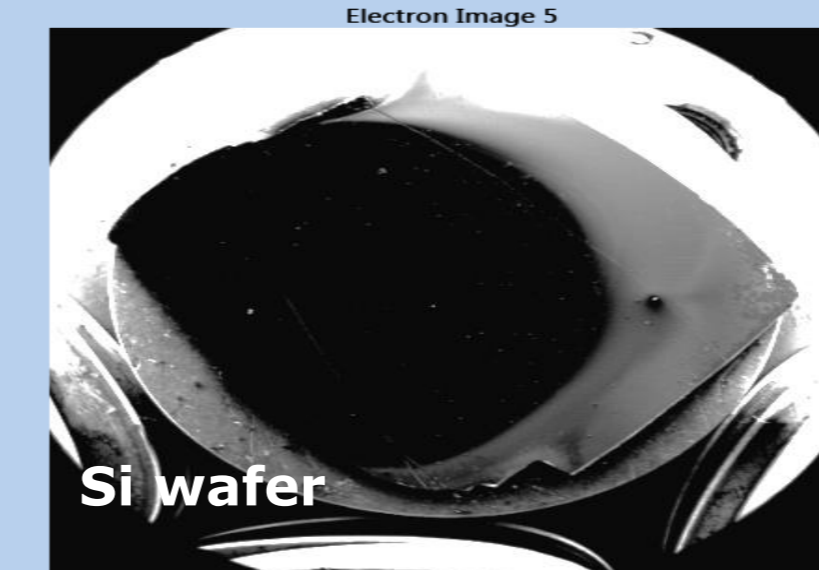
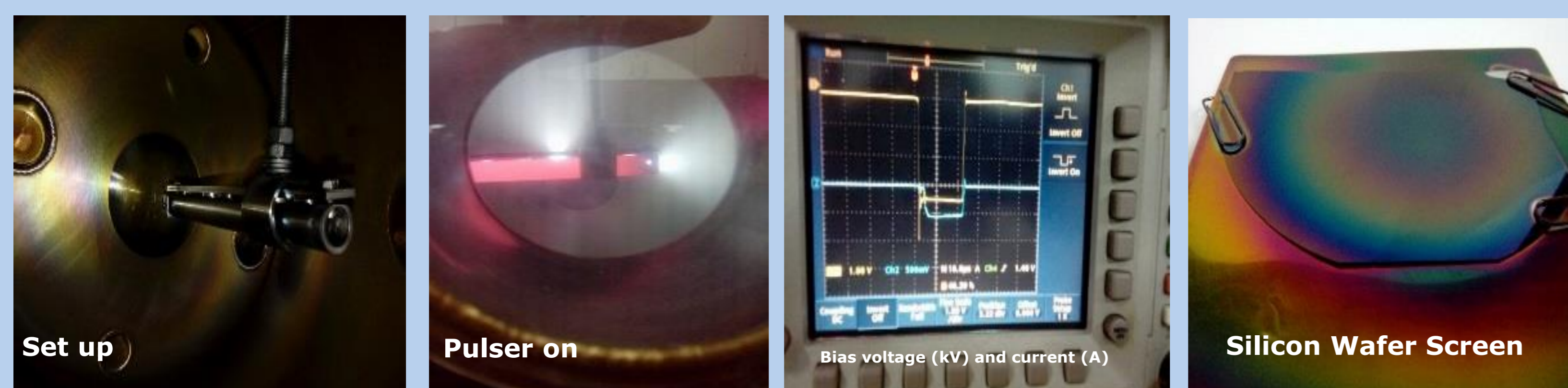
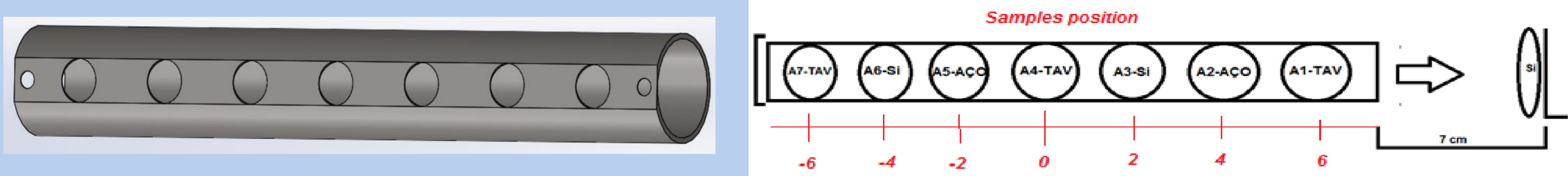
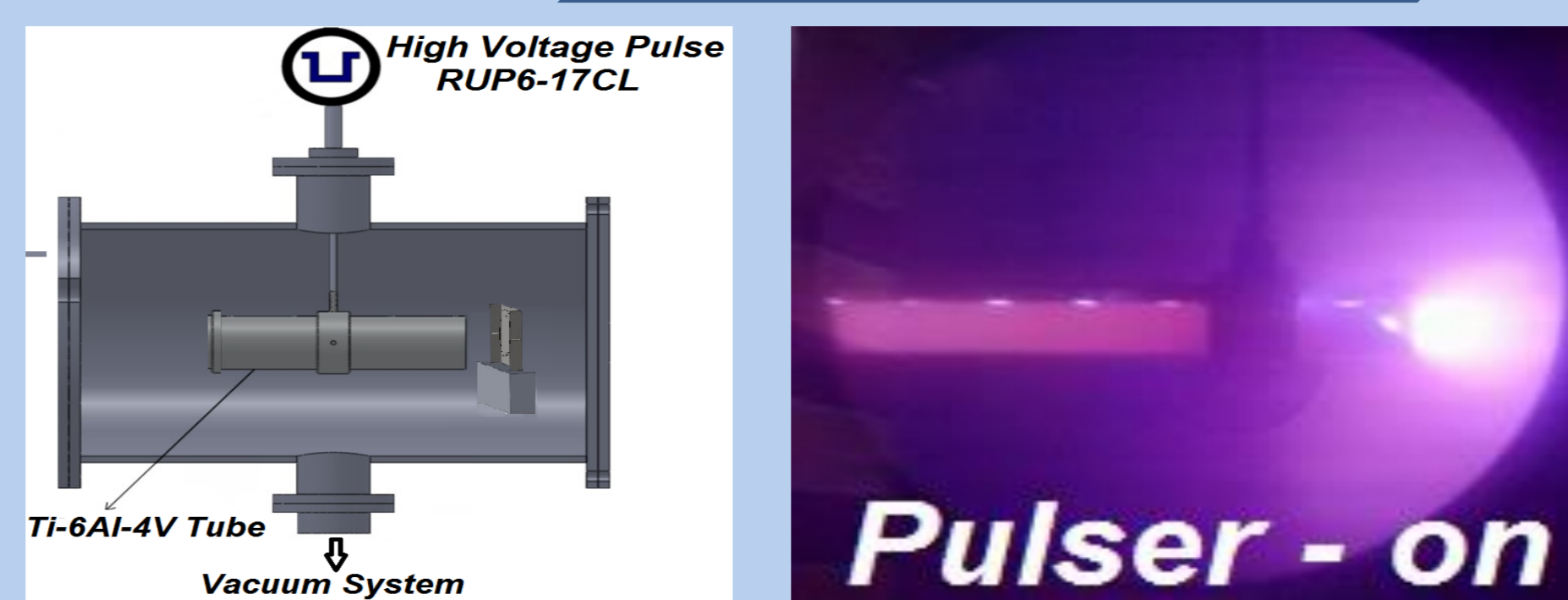
## EXPERIMENTAL

Ti-4Al-6V Tube  
11 mm diameter  
150 mm length

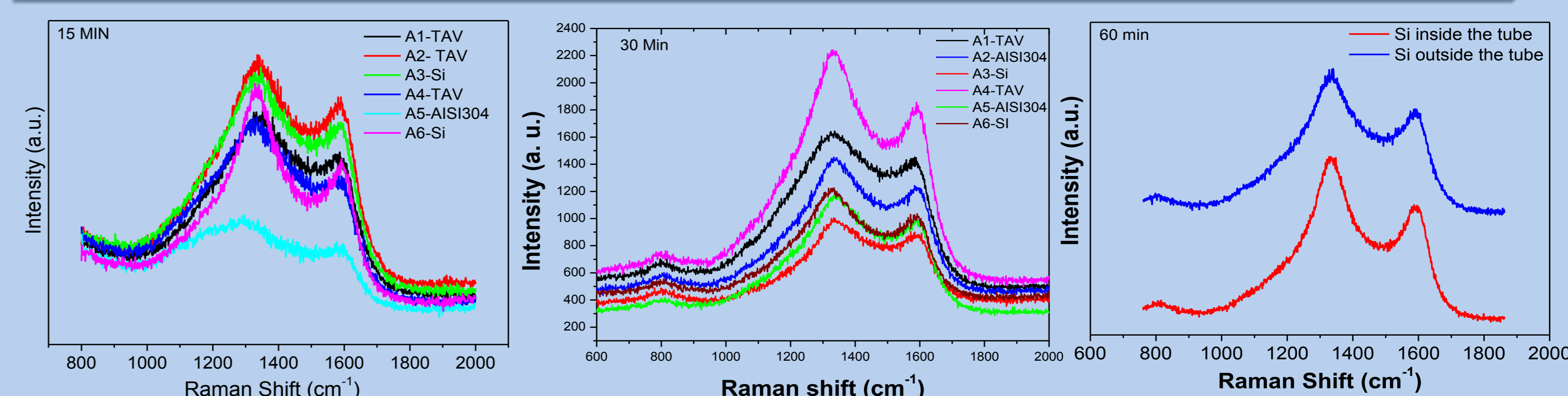
Gases  
Argon Cleaning  
C<sub>2</sub>H<sub>2</sub> Deposition

TAV, Si, AISI304  
Substrates  
20µs, 500 Hz  
15 to 120 min

Time (min)	Working Pressure (mBar)	H.V. pulse (kV) in the tube	Temperature (°C) in the tube
15	4.7x10 <sup>-2</sup>	2.63	546
30	4.3x10 <sup>-2</sup>	1.86	800
60	4.5x10 <sup>-2</sup>	2.70	345
120	4.9x10 <sup>-2</sup>	3.15	995
240	4.5x10 <sup>-2</sup>	2.94	990

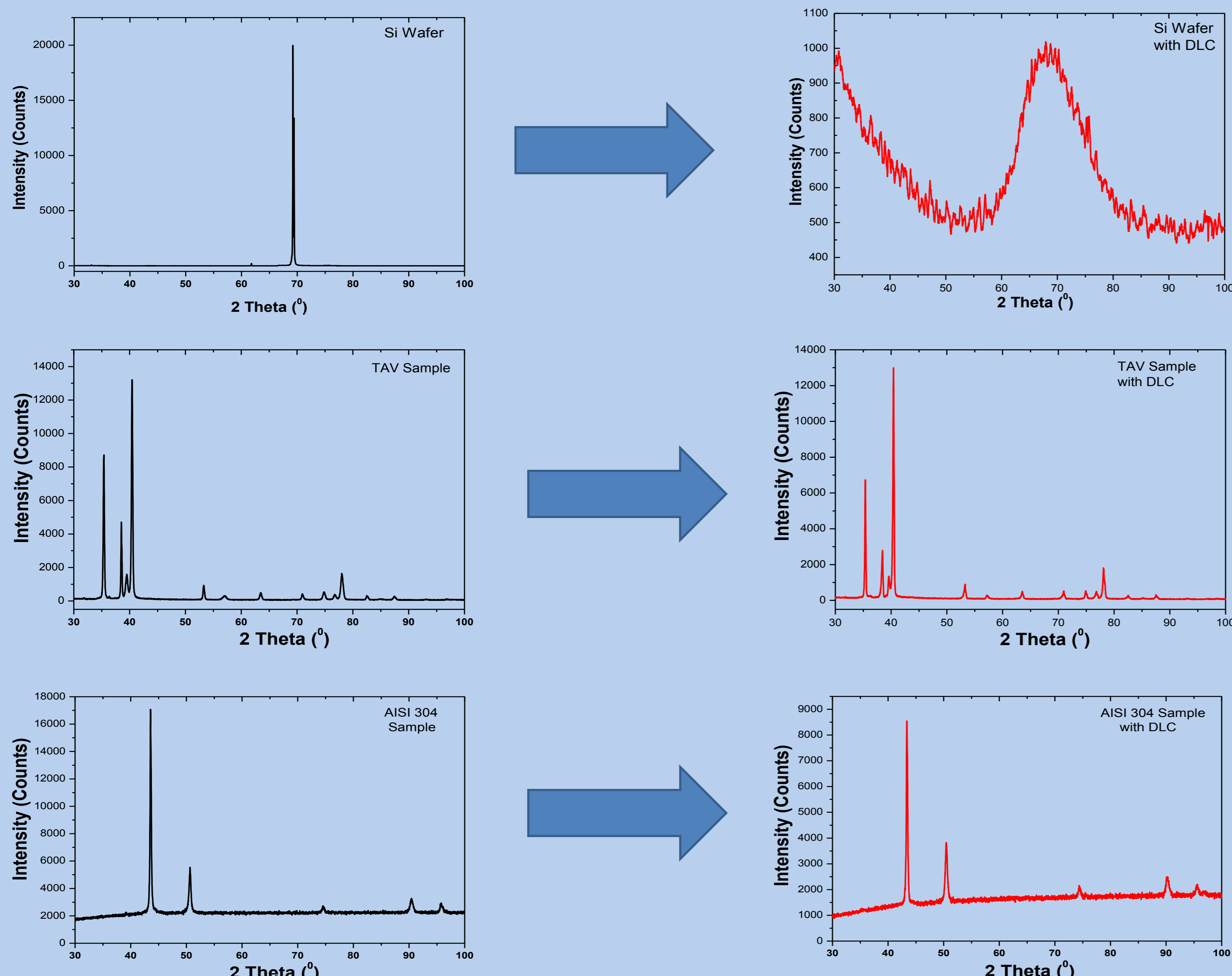


### Raman Scattering Spectroscopy



## RESULTS

### X-Ray Diffraction (XRD)



## CONCLUSIONS

- The experimental results demonstrated that a stable hollow cathode discharge was established inside the small diameter tube.
- DLC film thicknesses increased as function of the deposition time.
- The results showed that the inner surface of tube was completely coated by DLC films with high adhesion strength.
- The ID/IG ratio indicated the existence of mono crystalline graphite film with a good quality, totally adhered in the tube – 30 min and 120 min.
- Vitreous carbon structure was found for films deposited in 60 min and 240 min.
- silicon and steel targets for the deposition of the sputtered materials from the tubes show very good quality and adherence.