

# Supplementary Information

## 1 Precursors

Name	Abbrev	Process	Purity (%)	Supplier
Soda lime glass	SLG	back contact	Menzel Glaser	Fisher Scientific
Mo target	Mo	Back contact	99.95	Testbourne
Thiourea	TU	Solution/buffer	$\geq 99.0$	Sigma Aldrich
Cysteamine	CA	Solution	$\geq 99.2$	Chem-Impex Int.
Copper (II) oxide	CuO	Solution	99.98	Alfa Aesar
Zinc oxide	ZnO	Solution	99.99	Sigma Aldrich
Tin sulphate	SnSO <sub>4</sub>	Solution	$\geq 95$	Sigma Aldrich
Selenium shot	Se	Selenisation	99.999	Alfa Aesar
Cadmium sulphate	CdSO <sub>4</sub>	Buffer	$\geq 99.0$	Sigma Aldrich
Ammonium hydroxide	NH <sub>4</sub> OH	Buffer	28-30 wt%	Acros Organics
ZnO target	ZnO	Front contact	99.99	Plasmaterials
Al <sub>2</sub> O <sub>3</sub> :ZnO (0.5% by wt.)	AZO	Front contact	99.99	Innovnano

Table 1: The materials used throughout production

## 2 Absorber

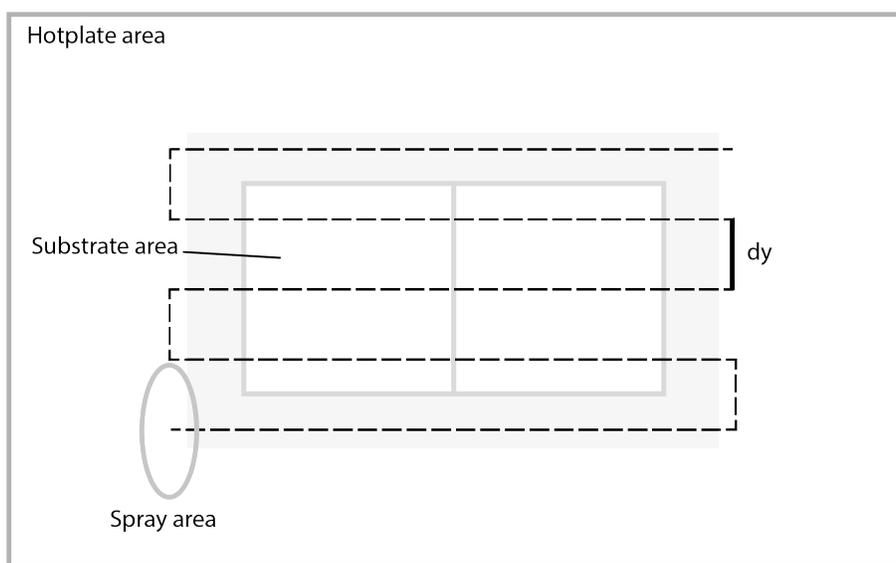


Figure 1: Image showing the motion of the deposition spot over the surface of the hotplate whilst pyrolysing

### 2.1 Deposition execution

We start the Labview program as the substrate touches the hotplate at temperature  $T$ ; a time  $t_1$  elapses before the stages begin to move. They move with velocity  $v$  and displace a distance  $dy$ .

After spraying a full layer it pauses for a time  $t_2$  before returning to the start and spraying again. It sprays  $n$  layers and pauses a time  $t_3$  after the last layer.

The solution is delivered to the nozzle at rate  $r_1$  where the nozzle atomises it at 120kHz with power  $p$ . The atomised solution is directed downwards using  $N_2$  gas flowing at rate  $r_2$  from a nozzle-to-hotplate distance of  $h$ .

## 2.2 Deposition parameters

Code	Parameter	Units	Value
T	Hotplate	°C	350
$t_1$	PreDwell	s	45
$t_2$	MidDwell	s	30
$t_3$	PostDwell	s	180
v	Stage speed	mm/s	40
dy	Sidestep	mm	10
$r_1$	Flow rate	ml/min	1.5
$r_2$	Gas flow	L/min	6
p	Power	W	4.5
n	Layers	-	12
h	Nozzle height	cm	5.5

Table 2: Table of spray deposition parameters

## 3 Selenisation

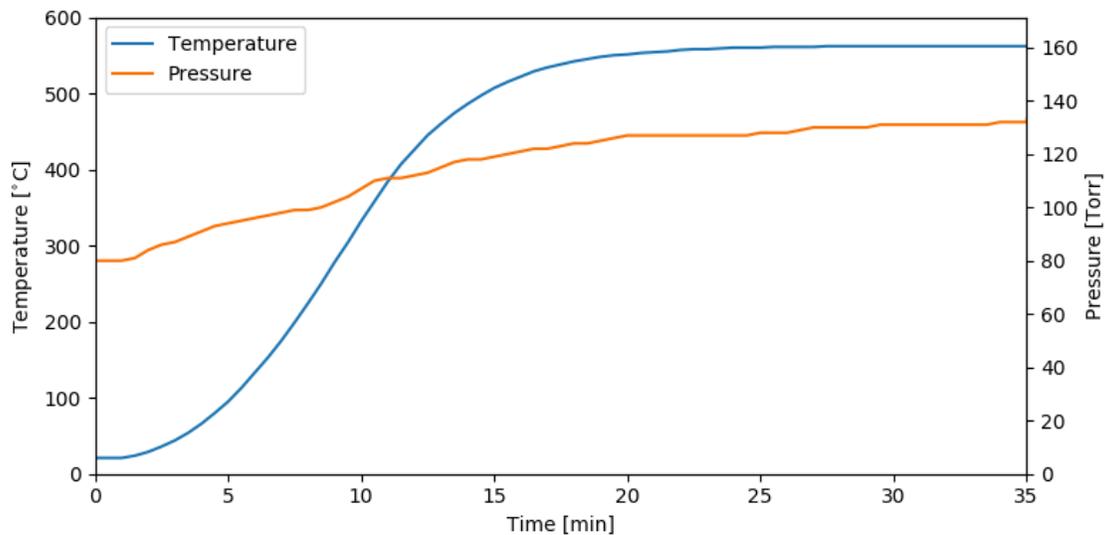


Figure 2: Temperature and pressure profile of selenisation

## 4 Buffer layer

1. Set circulating bath to 70°C
2. Add 183ml DI water to a beaker; leave to warm
3. When water temperature reaches 60°C:
  - Add 32.6ml  $\text{NH}_4\text{OH}$
  - Add 25ml  $\text{CdSO}_4$  (0.015M)
  - Start 15min timer
4. After 5mins add 12.5ml thiourea (1.5M) and submerge samples
5. When timer ends remove samples and rinse with DI water
6. Dry with compressed air

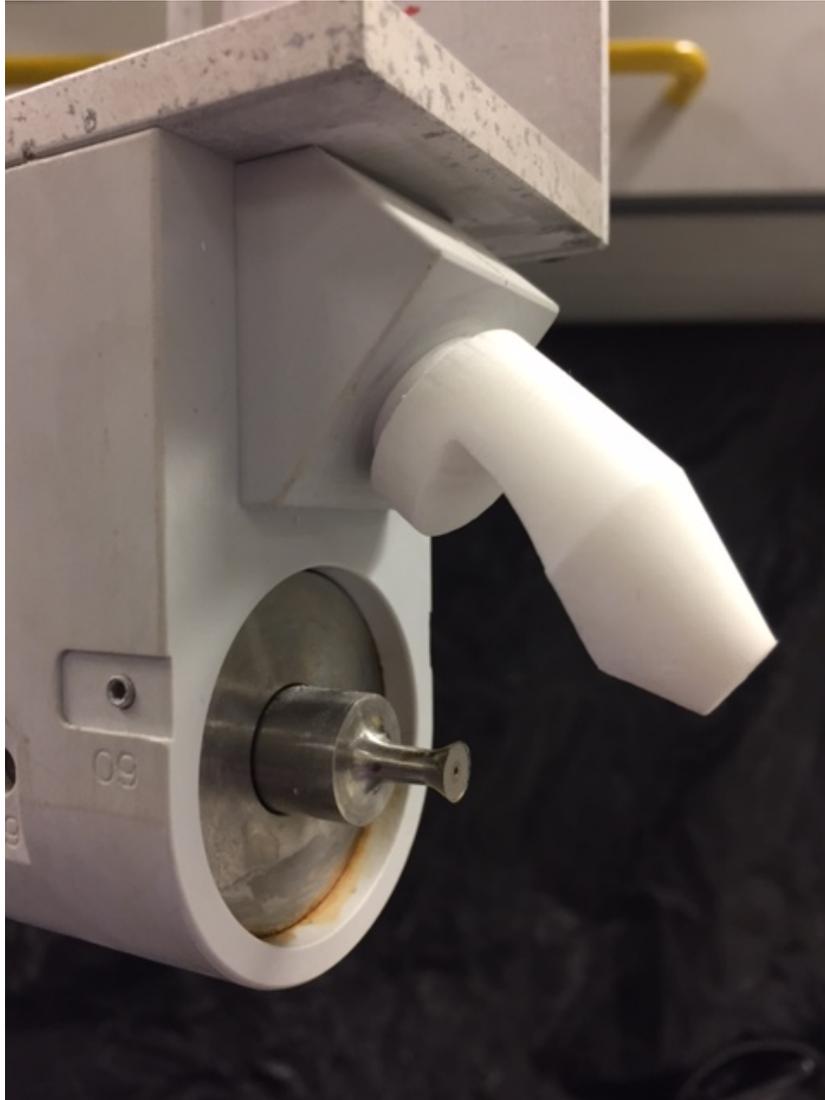


Figure 3: Photo of nozzle

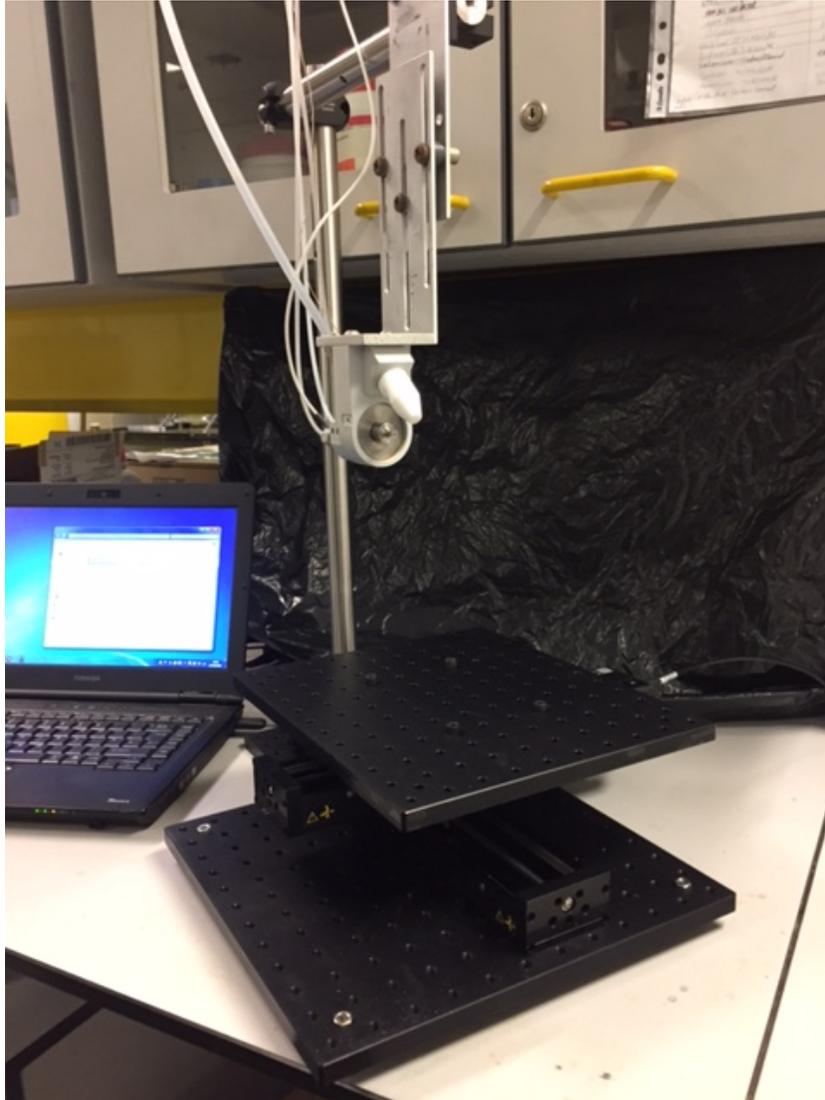


Figure 4: Photo of nozzle over stages

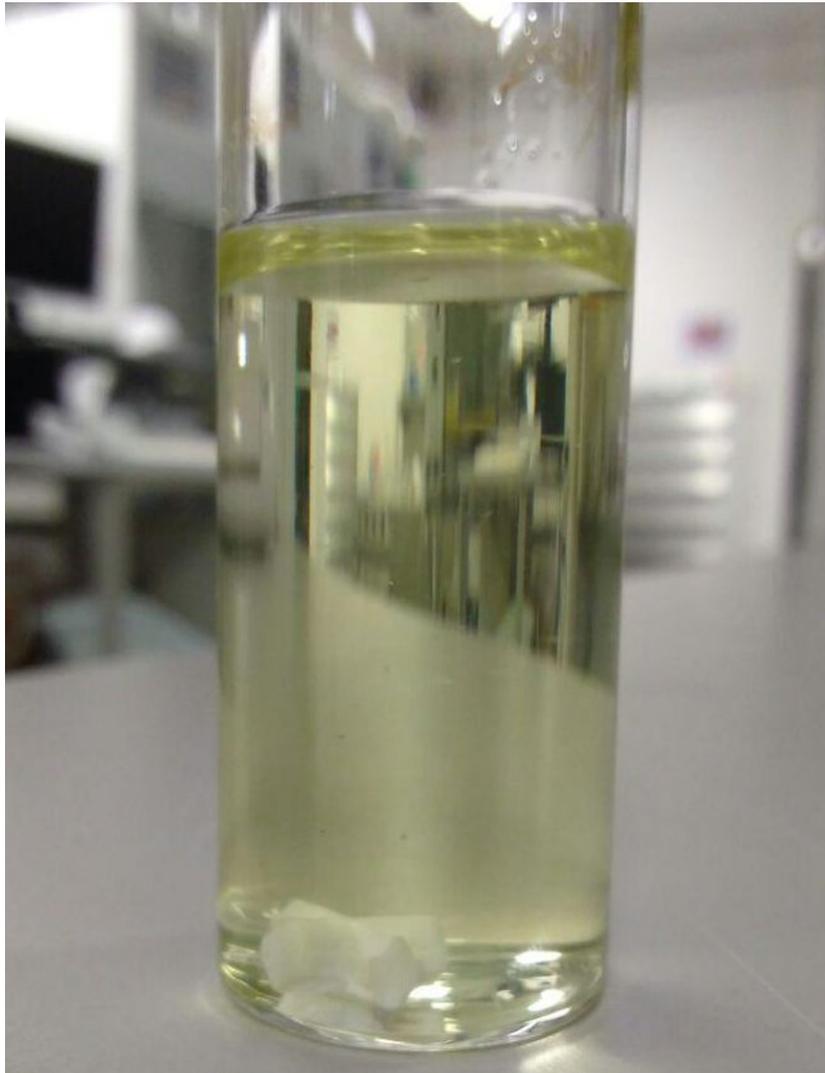


Figure 5: Photo of dissolved solution, pre-dilution



Figure 6: Photo of graphite box

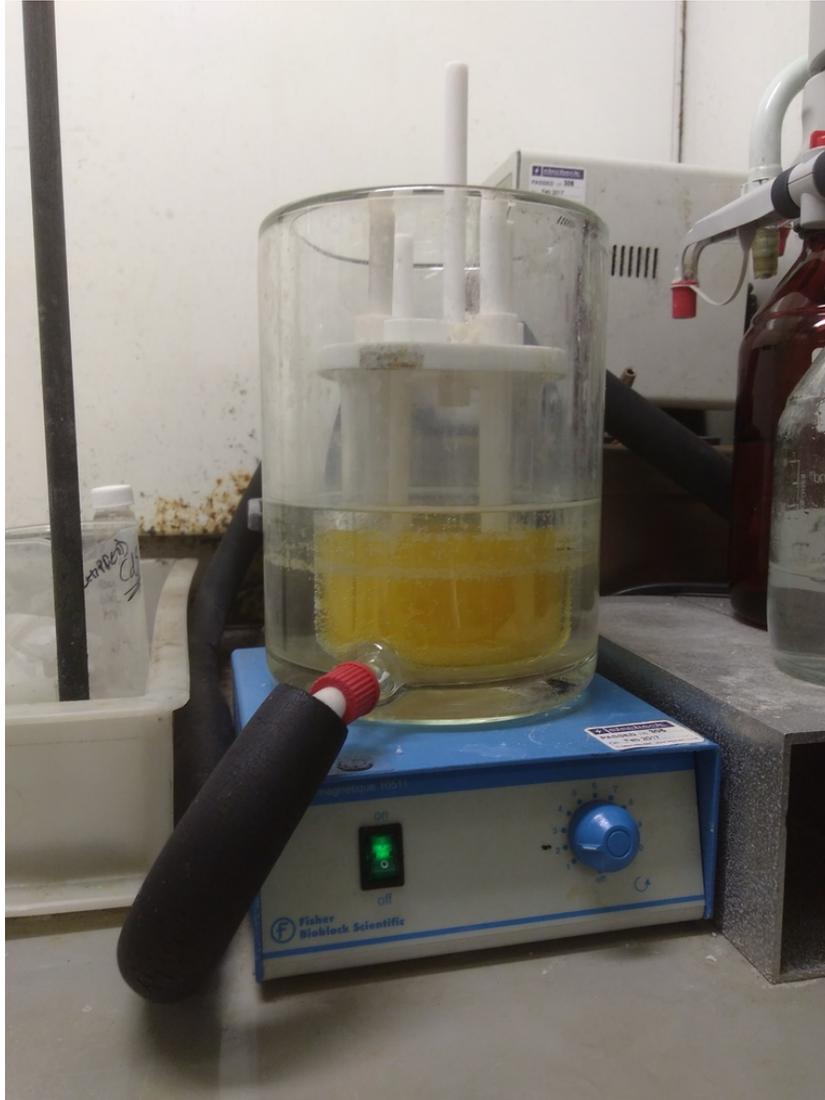


Figure 7: Photo taken during CdS deposition