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FTIR Characterization of Carbon Nanotube Films - Coatings for the microbolometer.

Progress report 2013-04-01 to 2013-05-31

from *Plasmionique Inc.*

for *DRDC Valcartier*

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DRDC-RDDC-2014-C90

Contract # W7701-125241

31 May 2013

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1. Growth and absorptance characterization of CNT films

In the last report, reflectance analyses performed on the old aligned carbon nanotube sample CS089N (CNT/Ni/TiN/Si) revealed a sharp drop in reflectance for the CNT coated sample as compared to its TiN coated Si substrate. New CNT samples are produced and analyzed hereafter for their transmittance, reflectance and absorptance in order to get a complete and more detailed picture of the near-to-mid IR absorbing properties of our CNTs.

1.1. *New CNT samples*

Three different materials namely titanium nitride (TiN), silicon nitride (Si_3N_4), and silicon dioxide (SiO_2) were used as sublayers on top of silicon substrates for the CNT growth. The samples with the electrically conductive TiN sublayer (CS122N) and the electrically insulating Si_3N_4 sublayer (CSiN-15N) led to CNT films that were suitable for the FTIR analyses. For the SiO_2 sublayer, both thermally grown commercial SiO_2 film (CSiOc01N) and sputtered SiO_2 coating (CSiO-07N) were used and none of them yielded a suitable CNT sample for FTIR analyses. It's worth mentioning however that for CSiO-07N, few CNTs spots were found on the sample after the CNT growth process but were removed from it by static electricity from a Petri dish cover. This is indicative of a very poor adhesion of the CNT layer to the SiO_2 sublayer. Therefore, it is very likely that CNTs were grown on our SiO_2 sublayer during the growth process but, due to their poor adhesion to the substrate, were almost completely swept away by gas flow or any other mean before the samples were removed from the PECVD reactor.

Detailed deposition parameters of all samples are available in the follow-up tables (A) and (B) of Annex 1.

1.2. *Specular, diffuse, and total reflectance*

Diffuse and total reflectance measurements were performed on samples CS122N and CSiN-15N using the integrating sphere accessory "A562-G/Q" with the FTIR spectrophotometer. The setup has been successfully modified to reduce the strength and the surface of mechanical contact between the CNT layers and the sphere. Thus, the samples are still of good quality and reliable subsequent SEM analyses could be performed to help correlate the optical and structural properties of the CNT films. Specular reflectance is calculated from the diffuse and total reflectance data and all the three spectra are shown in Figure 1 and Figure 2 respectively for CS122N and CSiN-15N. For comparison, specular reflectance spectra measured using the "A510/Q-T" accessory is also shown for each sample. The setup has also been modified for the latter accessory to avoid mechanical contact between its sample holder and the CNT layers. A plate from the heating stage unit "A599" has been used to fabricate a new custom sample holder adapted to the "A510/Q-T" accessory for fragile coatings such as CNTs, hence the added suffix A599-510 in the legend of the figures.

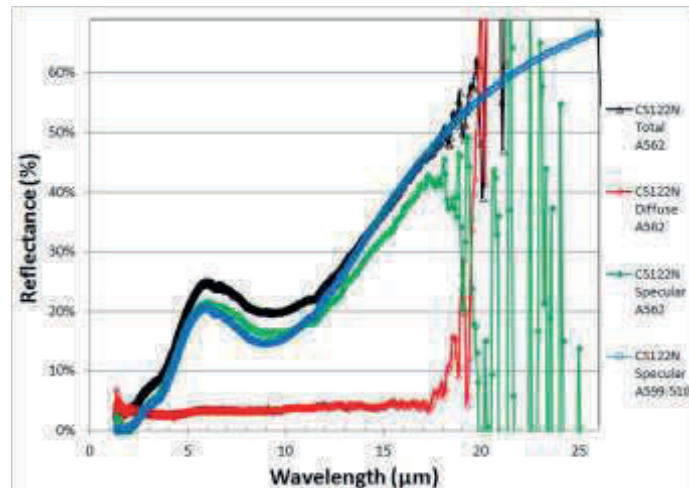


Figure 1 : Total, diffuse, and specular reflectance of a CNT/Ni/TiN/Si sample (CS122N) measured with the integrating sphere A562GQ and its specular reflectance measured with the A510QT accessory

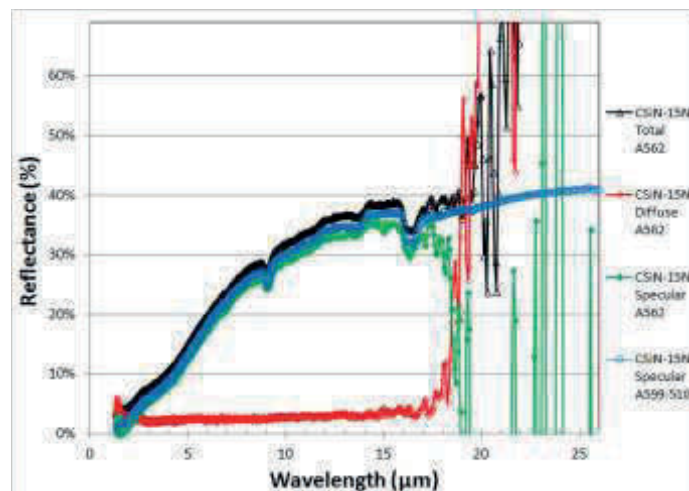


Figure 2 : Total, diffuse, and specular reflectance of a CNT/Ni/Si₃N₄/Si sample (CSiN-15N) measured with the integrating sphere A562GQ and its specular reflectance measured with the A510QT accessory

1.3. Transmittance and reflectance before and after CNT growth

Transmittance and reflectance measurements were performed on CNT samples CS122N and CSiN-15N as well as on their respective reference substrate S123N (Ni/TiN/Si) and SiN-16N (Ni/Si₃N₄/Si) using same successful procedures previously established for SiO₂ and Si₃N₄ samples [1]. Both types of measurement were performed using both the "A510/Q-T" and the "A562-G/Q" accessories with the same setup modifications described above. Especially for transmittance measurements with the A562GQ, the very low output signal limitation was overcome by using the high output power external MIR source mentioned in last report with an optimized combination of measurement parameters such as the aperture size, the signal gain, and the scanner velocity. The spectra obtained from the A510QT and A562GQ accessories are respectively shown in Figure 3 and Figure 4 for the pair (CS122N & S123N) and in Figure 5 and Figure 6 for the pair (CSiN-15N & SiN-16N).

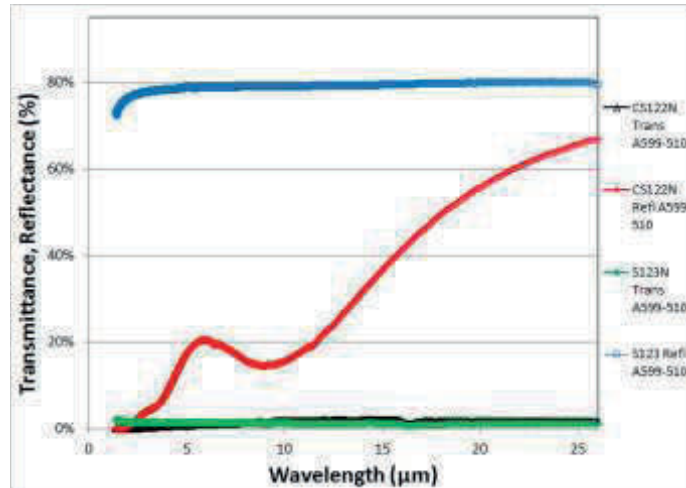


Figure 3 : Transmittance and specular reflectance of a CNT sample CS122N and its reference substrate S123N (Ni/TiN/Si) measured with the A510QT and its custom substrate holder from A599 plate

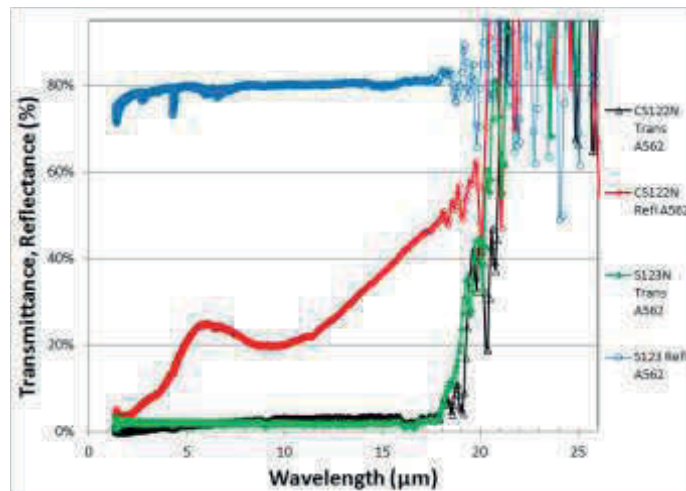


Figure 4 : Transmittance and total reflectance of a CNT sample CS122N and its reference substrate S123N (Ni/TiN/Si) measured with the integrating sphere A562GQ

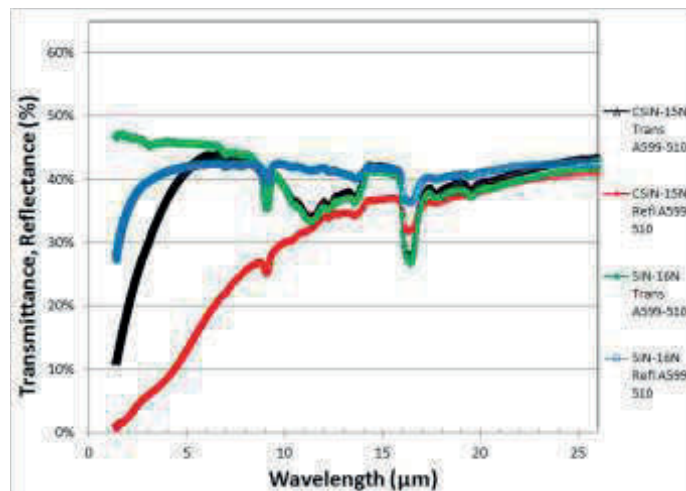


Figure 5 : Transmittance and specular reflectance of a CNT sample CSiN-15N and its reference substrate SiN-16N (Ni/Si₃N₄/Si) measured with the A510QT and its custom substrate holder from A599 plate

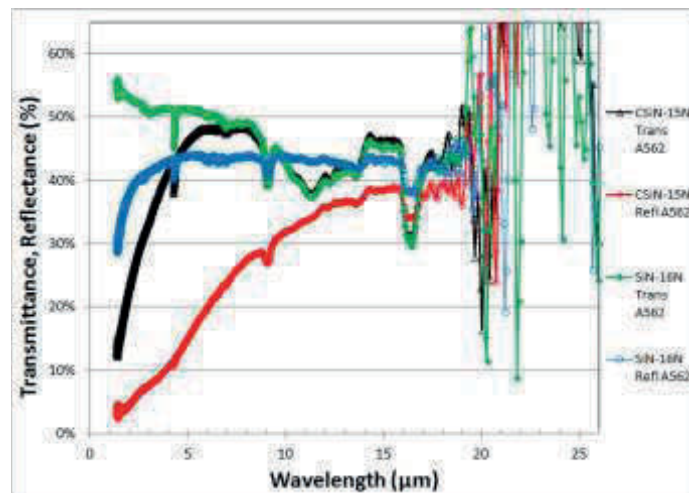


Figure 6 : Transmittance and total reflectance of a CNT sample CSiN-15N and its reference substrate SiN-16N (Ni/Si₃N₄/Si) measured with the integrating sphere A562GQ

1.4. Absorptance of the CNT layers

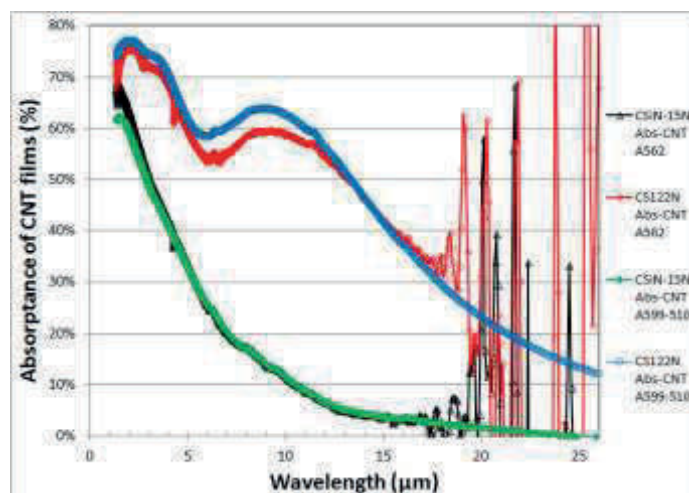


Figure 7 : Absorptance of the CNT layer of samples CSiN-15N and CS122N calculated from transmittance and reflectance data measured with the integrating sphere A562GQ and the A510QT accessory

The absorptance of the CNT layer of samples CS122N and CSiN-15N are calculated from the corresponding transmittance and reflectance data and shown in Figure 7. These results are quite different from the near-perfect black reported by Lehman *et al.* for their aligned CNTs of 162 μm of height [2]. Mizuno *et al.* also presented extremely low reflectance measurements of vertically aligned CNT arrays (less than 1-2%) indicating that it is possible to achieve extremely high absorptance at wavelengths ranging from the visible wavelengths to 200 μm [3].

Although both of our CNT films are still to be characterized by SEM, their height is not expected to be greater than 12.4 μm as previously measured for the sample CS089N (last report) which growth parameters were similar to CS122N. The quite lower absorptance of our films could therefore result to some extent from our much shorter CNT layer. The relatively high specular reflectance and low diffuse reflectance of our samples could be indicative of the CNT layer

density being so low that the almost completely specular reflection from the sublayer is predominant. The contrary could however also be true since it has been shown that for nanotubes that are close enough to touch, the coating's absorptance is about 75% while it rises to 99% when the CNTs are spaced a few tube diameters apart. [2] It is evidenced that the black body behavior is not an intrinsic nanotube property but stems from CNT coatings' unique forest structure, their sparseness and alignment [3].

The observed differences in absorptance for CS122N and CSiN-15N are thought to arise essentially from their different sublayer materials since their CNTs were grown simultaneously. Due to differences in their interfacial energy and interaction parameter, the different sublayer materials influence differently the nucleation and growth of the Ni catalyst layer leading to differences in the Ni layer properties (adhesion, particle size and distribution ...) [4]. This in turn influences differently the CNT properties such as their diameter, density, growth mode (top or bottom), adhesion to substrate, and length [5].

2. Ti and YBCO coatings for the dual-band microbolometer

2.1. *Sputter etching and new thick Ti deposition for posts*

a. Sputter etching of residuals

SEM and EDS analyses performed on few VO₂ based bolometer prototypes that are being fabricated revealed some of the Ti posts were wiped out during lithography processes and were to be replaced as mentioned in last report. However, observed deposits at the bottom of some vias were suspected to consist of residuals, silicon nitride, and titanium. Concerns have been raised about the possible deleterious effects of these deposits and the native oxide on the electrical conductivity at the junction between the new Ti posts to be deposited and the gold (or chromium for some samples) layer underneath. To avoid such situation that could prevent any electrical measurement from being made with the prototypes, we proposed to use the plasma etching capability of the new Plasmionique SPT330 sputtering system to sputter clean the samples prior to the new Ti deposition. The sputter etch rates of the various materials were measured and the appropriate etching parameters determined for each sample based on the evaluation of thicknesses to be removed without damaging the underneath structure of the devices. Detailed etching parameters of all samples are available in the follow-up table (C) of Annex 1.

b. New thick Ti films deposition for posts

The need for a high deposition rate and good electrical properties led to the previously optimized Ti deposition parameters using the "CVC New-Sputter" equipped with a four-inch Ti target (second to last report). However, since the posts were swept away during lithography processes, posts with denser Ti were desired for the new films as it could reduce their etching rate and strengthen their adhesion to the underneath layer. Since the new Plasmionique SPT330 sputtering system was required for the above-mentioned sputter etching of residuals, the new recipe for denser Ti deposition was developed using the same system with a new three-inch Ti target. This was intended to prevent a new native oxide layer to form during the breaking of the vacuum for sample transfer between the sputter cleaning process and the new Ti deposition. Detailed deposition parameters for the new thick and denser Ti film are available in the follow-up table (C) of Annex 1.

2.2. Y-Ba-Cu-O films to be used as thermistors

New Y-Ba-Cu-O samples (YBCO-F to YBCO-J) were produced using the Plasmionique SPT330 sputter with deposition parameters chosen based on previous optimization results (last and second to last reports). The O₂ gas flow content in the Ar+O₂ gas mixture was kept at 10% in the 5-15% range previously determined and the working pressure was kept in a more conventional magnetron sputtering pressure range (2.5-15 mTorr) as compared to up to 150 mTorr previously for YBCO-A for example. Detailed deposition parameters for the YBCO samples are available in the follow-up table (C) of Annex 1. Film thickness and hence average growth rate were measured using the same lithographic and HCl wet etch techniques described in last reports. The resistivity and temperature measurement curves of the samples are shown in Annex 2. Their temperature coefficient of resistance (TCR) extracted from those data are available in Table 1 below.

Table 1 : Properties and few deposition parameters of various YBCO samples

Sample	Total Ar+O ₂ deposition pressure	O ₂ /(Ar+O ₂) gas flow ratio	Thickness	Growth rate	Temperature coefficient of resistance (TCR)	Average resistivity at room temperature			
						(mTorr)	(nm)	(nm/min)	(%/K)
Reported YBCO [6]					-3.4%				
YBCO-A	150	10%	116	0.6	-1.8%	1400	513	37%	
YBCO-B	12	10%	252	2.0	-1.6%	2190	722	33%	
YBCO-C	12	10%	210	1.7	-1.5%	614	155	25%	
YBCO-D	42	10%	118	0.9	-1.5%	866	200	23%	
YBCO-E	147	10%	47	0.4	-1.0%	646	289	45%	
YBCO-F	5	10%	250	2.1	-1.5%	221	47	21%	
YBCO-G	5	10%	198	1.7	-1.6%	1330	326	25%	
YBCO-H	10	10%	138	1.2	-1.3%	883	200	23%	
YBCO-I	15	10%	137	1.2	0.0%	1.5	0.41	28%	
YBCO-J	2.5	10%	70	1.7	-0.7%	3.2	0.28	9%	

Although the coatings of samples such as YBCO-A deposited at a relatively high sputtering pressure (150 mTorr) are supposed to have a composition much closer to a stoichiometric YBCO [1], their highest measured average TCR was -1.8%/K which is only ~53% of the reference reported value of -3.4%/K [6]. Moreover, YBCO-E, which was deposited at quite a similar pressure (147 mTorr) exhibited a quite different average TCR of -1.0%/K, which is even lower than the -1.6%/K obtained for YBCO-G that was deposited at 5 mTorr. It thus appears that the advantage of getting a coating with a composition closer to the stoichiometric YBCO by

increasing the sputtering working pressure do not relate in a simple manner to getting higher TCR. Reproducibility of the grown YBCO properties might also be a more important issue at higher pressures (YBCO-A and YBCO-E) than at lower pressure (YBCO-F and YBCO-G) as shown by the TCR data. Although a high TCR is the more important criteria for the use of our YBCO films as thermistors, it might be of good advice to use working pressures in the 5 to 15 mTorr range since our experiments show there's no guaranty of higher TCR at higher pressures while deposition challenges increase with such high working pressures. Elsewhere, porous film structures obtained at higher working pressures would've become another issue for the lithography patterning needed for our devices [7]. Pressures lower than 5 mTorr are not advised since it has been shown that substrate (Si) contaminants could be incorporated inside the YBCO coatings when the resputtering effect of the sample is too strong [1], which is more likely to occur at those low working pressures.

For YBCO-I, both negative and positive TCR values in the -1.2%/K to +0.9%/K were obtained with a strange average value of 0%/K. These results as well as those of YBCO-J are however not to be considered seriously since the YBCO target has been found to exhibit cracks after those last two depositions. The fissured target has been replaced with a newer and similar target which is to be used for upcoming depositions.

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Annex 1: Samples characteristics and follow-up table (#7)

Nomenclature for samples in the following table:

Si-0X :	Si substrate with identification number 0X (SN0X for old samples).
ALN01 :	Bare Al ₂ O ₃ substrate, number 01.
Ti-0X:	Si substrate with Ti coating, number 0X.
Bolo9Ti:	Ti coating, on a special substrate (Bolo9 is the name of a device prototype used as substrate).
SX01 :	Si substrate with a thermally grown oxide layer at 1000 °C in O ₂ , number 01.
S012 :	Si substrate with TiN coating, number 012.
AL07 :	Al ₂ O ₃ substrate with TiN coating, number 07.
SiN-0Y :	Si ₃ N ₄ film with identification number 0Y deposited on an identified substrate.
SiO-0Z :	SiO ₂ film with identification number 0Z deposited on an identified substrate.
VO2-XX :	VO _x film with identification number XX deposited on an identified substrate.
YBCO-YY :	Y-Ba-Cu-O film with identification number YY deposited on an identified substrate.
SX18N :	SX18 with Ni coating.
S100N :	S100 with Ni coating.
SN11N :	SN11 (Si substrate) with Ni coating, (usually for Ni calibration).
ALN02N :	ALN02 with Ni coating.
CS100N :	CNT grown on S100N
CALN28N :	CNT grown on ALN28N.
Ti-18_pe:	Plasma etching of sample Ti-18 using the Plasmionique SPT330 sputter.

A. Sputter deposition with the "CVC New-Sputter"

Sample name	Date	New-Sputter (NS)	Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Varian - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Pre-sputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Varian - CDG (mTorr)	Deposition Total Pressure - Varian - ConvecTorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
TiN	12/07/09	NS		1	2	DC -1	TiN	10	Holder	10	3	1.5E-07	3.6E-07			98.6		5	10	49	0.20	50	0	0	1.23	3	3.7	2.1			4h00 pumping - Test before New CNTs
Ni		NS		8	4	RF-1	Ni	10	Holder	45	3				100.4		5	10	81			0	30	0.75	1.7	1.3	1.5			Test before New CNTs	
S118	12/07/10	NS		1	2	DC -1	TiN	10	Si	10	3	1.5E-07	3.4E-07	50	50	98.8		30	30	48	0.20	50	0	0	1.2	2.6	3.6	2.1	100	3h00 pumping - Heating: 25V,25A - For CNTs	
S119									-					50	50	98.8		30	30	48	0.20	50	0	0	1.2	2.6	3.6	2.1	100	3h00 pumping - Heating: 25V,25A - For CNTs	
S120									-					50	50	98.8		30	30	48	0.20	50	0	0	1.2	2.6	3.6	2.1	100	3h00 pumping - Heating: 25V,25A - For CNTs	
S121									-					50	50	98.8		30	30	48	0.20	50	0	0	1.2	2.6	3.6	2.1	100	3h00 pumping - Heating: 25V,25A - For CNTs	
Ni	12/07/18	NS		8	4	RF-1	Ni	10	Holder	45	3	1.9E-07	4.4E-07			100.4	5.5	30	0	76		0	10	5.66	12	10	7.8			1h30 pumping, Cleaning	
									-							100.4	4.3	0	30	81		0	30	0.75	1.7	1.3	1.5				

Sample name	Date	New-Sputter (NS)	Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Varian - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Resputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Varian - CDG (mTorr)	Deposition Total Pressure - Varian - ConveTorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
Ni	12/07/19	NS		8	4	RF-1	Ni	10	Si	45	3	1.2E-07	2.8E-07			100.4	4.7	30	0	721		0	0	10	5.76	13	10	7.88			1h30 pumping, Test with substrate
Ni	12/07/20	NS		8	4	RF-1	Ni	10	Si	45	3	2.3E-07	5.4E-07			100.4	4.3	10	2.5	807		0	0	29	0.74	1.6	1.3	1.55	2.78	OK Coating observed	
Ni	12/07/23	NS		8	4	RF-1	Ni	10	Si	45	3	2.9E-07	6.7E-07			100.4	4.1	30	0	729		0	0	10	5.58	12	10	7.88			0h40 pumping, Cleaning
S118N	12/07/23	NS		8	4	RF-1	Ni	10	S118	45	3	2.8E-07	5.9E-07			100.4	4.8	20	0	727		0	0	10	5.72	13	10	7.9			1h15 pumping, Ni for CNT
S118N									S118							100.4	5.4	5	2.5	813		0	0	30	0.76	1.4	1.3	1.56	2.78		
SN18N									Si							100.4	5.4	5	2.5	813		0	0	30	0.76	1.4	1.3	1.56	2.78		
S119N	12/07/23	NS		8	4	RF-1	Ni	10	S119	45	3	3.0E-07	6.3E-07			100.4	5.5	15	0	725		0	0	10	5.76	13	10	7.93			1h05 pumping, Ni for CNT
S119N									S119							100.4	4.3	5	3.75	816		0	0	30	0.76	1.5	1.3	1.57	4.17		
SN19N									Si							100.4	4.3	5	3.75	816		0	0	30	0.76	1.5	1.3	1.57	4.17		
S120N	12/07/23	NS		8	4	RF-1	Ni	10	S120	45	3	2.9E-07	6.0E-07			100.4	5.5	15	0	72		0	0	10	5.79	13	10	7.95			1h10 pumping, Ni

Sample name	Date	New-Sputter (NS)	Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Varian - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Presputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Varian - CDG (mTorr)	Deposition Total Pressure - Varian - ConveTorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
																				8											for CNT
SI20N									SI20							100.4	4.3	5	5	-814		0	0	30	0.76	1.4	1.3	1.5	8	5.56	
SN20N									SI							100.4	4.3	5	5	-814		0	0	30	0.76	1.4	1.3	1.5	8	5.56	
SiTi-I	12/07/31		NS	6	4	RF-1	Ti	10	Si	180		1.1E-07	2.8E-07			100.4	3.8	2	0	-128		0	15	8.7	20	15	11.9			5h20 pumping + gas, Shutter closed	
									-							200.9	0.8	2	3.6	-162		0	4.1	2.22	4.8	3.6	4.0	1	24	4 substrate passages in front of target for adhesion layer	
SiTiAu-1				2	2	RF-1	Au	13	SiTi-I	20	3					50	1.8	5	10	-204		0	4.1	2.25	5	4	4.1	168		Gold layer for Mirror to be used for FTIR	
Ni	12/10/09		NS	8	4	RF-1	Ni	10	holder	45	3	5.9E-07				100.4	5.4	5	0	-771		0	10	5.7	13		7.98			1h00 pumping after cleaning, Test	
									-							100.4	4.1	5	0	-821		0	30	0.75	1.6		1.5	8			
Ni	12/10/09		NS	7	2	RF-1	Ni	10	holder	45	3					40.1			0											No plasma - high reflection not reduced	
TEN	12/10/10		NS	1	2	DC-1	TEN	10	Holder	10													0							Gas Alarm in the cleanroom, pumping all	

Sample name	Date	New-Sputter (NS)	Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Vartan - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Resputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Vartan - CDG (mTorr)	Deposition Total Pressure - Vartan - ConvecTorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
TiN	12/10/11	NS		1	2	DC -1	TiN	10	Holder	10	3	1.4E-07	4.4E-07			98.6		0	25	44	0.228	50	0	30	2.02	4.7		4			Cleaning
									-							98.6		0	15	47	0.215	50	0	0	1.26	2.8		2.1			Cleaning
S122	12/10/11	NS		1	2	DC -1	TiN	10	Si	10	3	1.7E-07	3.7E-07		50	98.8		30	30	48	0.208	48.	0	0	1.19	2.4		2.2			3h00 pumping - Heating: 25V, 25A - For CNTs, DC Power and Voltage are -159W and 212V in the soft, different from MDX-1K controller values! The negative power prevents from automatic Wmin control of deposition. Chromometer used
S123									-					50	98.8		30	30	48	0.208	48.	0	0	0	1.19	2.4		2.2			idem
S124									-					50	98.8		30	30	48	0.208	48.	0	0	0	1.19	2.4		2.2			idem
S125									-					50	98.8		30	30	48	0.208	48.	0	0	0	1.19	2.4		2.2			idem

Sample name	Date	New-Sputter (NS) Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Varian - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Resputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Varian - CDG (mTorr)	Deposition Total Pressure - Varian - ConvecTorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
SiO-07	12/10/12	NS	8	4	RF-1	SiO2	10	Si	45	3	2.1E-07	4.4E-07			400		50	0	-642			1	4	2.35	5.4	4.5	4.29			1h10 pumping
SiO-07			8	4				-							400		0	11.3	-622			1	4	2.08	4.7	4	3.78	100	100	Throttled - Software Fw/Reflecte d RF Power (476/39W) is very different from RFX-600 controller values (404/4W)! Automatic Wimin control of deposition from software values is still possible but not reliable. Chromomete r used
SiO-08			8	4				-							400		0	11.3	-622			1	4	2.08	4.7	4	3.78	100	100	idem
SiO-09			8	4				-							400		0	11.3	-622			1	4	2.08	4.7	4	3.78	100	100	idem
SiO-10			8	4				-							400		0	11.3	-622			1	4	2.08	4.7	4	3.78	100	100	idem
SiN-15	12/10/12	NS	8	4	RF-1	Si3N4	10	Si	45	3	2.1E-07	4.7E-07	200	200	200		15	0	-29		1	7	4.37	10	8.5	6.45			2h00 pumping+	

Sample name	Date	New-Sputter (NS)	Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Varian - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Resputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Varian - CDG (mTorr)	Deposition Total Pressure - Varian - Convectorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
SIN-15				8	4									20	20	300		20	8.8	-		1		7	3.1	7.1	5.9	5.2	100		gas + 0h35 of 4x50 deg step-heating + 20min stabilization + Presputterin g
SIN-16				8	4									20	20	300		20	8.8	-		1		7	3.1	7.1	5.9	5.2	100	Deposition after 0h50 of heating. Throttled - Software Fw/Reflecte d RF Power (420/38W) is very different from RFX-600 controller values (301/2W)! Watt*Min-Done was 3125 at the end in software instead of the real 2651 for 8,84 min needed for 100 nm	
SIN-17				8	4									20	20	300		20	8.8	-		1		7	3.1	7.1	5.9	5.2	100	idem	

Sample name	Date	New-Sputter (NS)	Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Varian - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Resputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Varian - CDG (mTorr)	Deposition Total Pressure - Varian - ConveTorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
SIN-18				8	4									20	0	300		20	8,8	-		1	7		3.1	7.1	5.9	5.2	100		idem
Ni	12/10/15	NS	NS	8	4	RF-1	Ni	10	holder	45	3	3.8E-07	9.2E-07			100		0	75	-		0	10	5.63	13	10	7.9	5		0h30 pumping for cleaning	
S122N	12/10/15	NS	NS	8	4	RF-1	Ni	10	S122	45	3	2.8E-07	6.1E-07			100		25	0	-		0	10	5.73	13	10	8.0	2		1h40 pumping, Ni for CNT	
S122N									S122							100		5	2.5	-		0	30	0.76	1.5	1.3	1.5	9	2.7	8	
SiO-07N									SiO-07							100		5	2.5	-		0	30	0.76	1.5	1.3	1.5	9	2.7	8	
SIN-15N	12/10/15	NS	NS	8	4	RF-1	Ni	10	SiN-15	45	3	3.1E-07	6.3E-07			100		15	0	-		0	10	5.79	13	10	8.0	1		1h15 pumping, Ni for CNT	
SIN-15N									SiN-15							100		5	2.5	-		0	30	0.76	1.7	1.3	1.6		2.7	8	
SiOe01N									SiOe01							100		5	2.5	-		0	30	0.76	1.7	1.3	1.6		2.7	8	
Ni	12/10/16	NS	NS	8	4	RF-1	Ni	10	holder	45	3	4.3E-07	9.3E-07			100		0	45	-		0	10	5.68	13	10	7.9	7		0h35 pumping for cleaning	
S123N	12/10/16	NS	NS	8	4	RF-1	Ni	10	S123	45	3	3.0E-07	6.2E-07			100		5	0	-		0	10	5.79	13	10	7.9	7		1h05 pumping, Ni for CNT	
S123N									S123							100		5	2.5	-		0	30	0.76	1.7	1.3	1.5	8	2.7	8	
SiO-08N									SiO-08							100		5	2.5	-		0	30	0.76	1.7	1.3	1.5	8	2.7	8	

Sample name	Date	New-Sputter (NS)	Plasmionique sputter (SPT)	Gun Number	Gun/Target diameter (")	Mode: DC or RF (Contactor/Generator 1 or 2)	Target	Target→Substrate Distance (cm)	Substrate (If in rotation)	Toggle Half-Angle (±X°)	Toggle Velocity	Base Pressure - Pfeiffer - Cold Cathode (Torr)	Base Pressure - Varian - Ion Gauge (Torr)	Real Temperature (°C)	Temperature Setpoint (°C)	Sputtering Power (W)	Reflected Power (W)	Resputtering Time (min)	Sputtering Time (min)	DC Bias in RF mode or Voltage in DC mode (V)	Current in DC mode (A)	N2 adjusted flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Varian - CDG (mTorr)	Deposition Total Pressure - Varian - ConveTorr (mTorr)	Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
SIN-16N	12/10/16	NS	NS	8	4	RF-1	Ni	10	SiN-16	45	3	2.9E-07	5.8E-07			100		15	0	73		0	0	10	5.81	13	10	7.9			1h15 pumping, Ni for CNT
SIN-16N									SiN-16							100		5	2.5	82		0	0	30	0.77	1.8	1.3	1.5		2.7	
SiOe02 N									SiOe0-2							100		5	2.5	82		0	0	30	0.76	1.7	1.3	1.6		2.7	
S124N	12/10/16	NS	NS	4	2	RF-1	Ni	10	S124	10	3	3.7E-07	7.6E-07			40		15	0	67		0	0	28	16	37	28	23			1h00 pumping, Ni for CNT
S124N									S124							40		10	4.5	73		0	0	28.5	0.73	1.5	1.4	1.5		0	No coating (edge) observed! To be coated again
SiO-09N									SiO-09							40		10	4.5	73		0	0	28.5	0.73	1.5	1.4	1.5		0	idem
SIN-17N	12/10/16	NS	NS	4	2	RF-1	Ni	10	SiN-17	10	3	4.0E-07	8.1E-07			40		15	0	67		0	0	16.2	16.2	38	29	23			0h55 pumping, Ni for CNT
SIN-17N									SiN-17							40		5	4.5	74		0	0	0.73	0.73	1.6	1.3	1.4		7.1	Coating is visible! Should have done 3min/4.3nm
SiOe03 N									SiOe0-3							40		5	4.5	74		0	0	28.2	0.73	1.6	1.3	1.4		7.1	Coating is visible! Should have done 3min/4.3nm

B. CNT growth with the PECVD system

Echantillons	Date	Pression de base - Jauge Pfeiffer (Torr)	Distance Substrat → Cible ou → Entrée μ-ondes (cm)	Substrat	Porte-substrats (PECVD)	Dépôt - Puissance (W)	Dépôt - Durée (min)	Dépôt - Température (°C)	Dépôt - Pression (mTorr)	Dépôt - Gaz H ₂ (%)	Dépôt - Gaz CH ₄ (%)	Dépôt - Gaz C ₂ H ₂ (%)	Epaisseur (nm)	Polarisation DC (V)	Autres - commentaires (Chiffre en italique = valeur mesurée précédentes)
CSN18N	12/10/17	2.2E-07	27	SN18N	BN	900	20	700	6000	80	20			0	CNTs delaminates, poor Ni adhesion
CSN19N	12/10/17	2.2E-07	27	SN19N	BN	900	20	700	6000	80	20			0	CNTs delaminates, poor Ni adhesion
CSN20N	12/10/17	2.2E-07	27	SN20N	BN	900	20	700	6000	80	20			0	CNTs delaminates, poor Ni adhesion
CSN21	12/10/17	2.2E-07	27	SN21	BN	900	20	700	6000	80	20			0	FTIR reference for 3 samples above, same Si - No Ni, no CNT
GS118N	12/10/18	1.4E-07	27	S118N	BN	900	20	700	6000	80	20			0	CNTs on Ni/TiN/Si
GS119N	12/10/18	1.4E-07	27	S119N	BN	900	20	700	6000	80	20			0	CNTs on Ni/TiN/Si
GS120N	12/10/18	1.4E-07	27	S120N	BN	900	20	700	6000	80	20			0	CNTs on Ni/TiN/Si
CS121	12/10/18	1.4E-07	27	S121	BN	900	20	700	6000	80	20			0	FTIR reference for 3 samples above but heating partially evaporates TiN - Avoid heating for next references
CS122N	12/12/14	1.8E-07	27	S122N	BN	900	20	700	6000	80	20			0	CNTs - for FTIR and SEM analyses
CSiN-15N	12/12/14	1.8E-07	27	SN19N	BN	900	20	700	6000	80	20			0	CNTs - for FTIR and SEM analyses
CSiO-07N	12/12/14	1.8E-07	27	SN20N	BN	900	20	700	6000	80	20			0	Small CNT spots delaminate due to static electricity from a Petri dish cover - Poor Ni adhesion?
CSiO-01N	12/12/14	1.8E-07	27	SN21	BN	900	20	700	6000	80	20			0	No CNTs - Poor Ni adhesion? CNT delamination by gas flow in reactor?

C. Sputter deposition with the "Plasmionique SPT330" system

Sample name	Date	Base Pressure - Vartan - Ion Gauge (Torr) Prestl	Gun Number	Target Material	Gun/Target diameter (")	Substrate	Substrate Position (mm)	Target→Substrate Distance (cm)	Substrate Rotation Velocity (rpm)	Temperature Setpoint Value SV (°C)	Temperature Probe Value PV (°C)	Real Sample Temperature (°C) from TCI (°C)	Mode-Match : RF-2, DC-1	Sputtering FW Power (W)	Reflected Power (W)	Cathode Voltage (V)	Presputtering Time (min)	Sputtering Time (min)	Bias FW Power - sample (W)	Bias Reflected Power (W)	Bias Voltage - sample (V)	Bias Duration (min)	N2 flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Pressure Control: Manual, Throttle-Flow	Throttle Valve (% Closed)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Pfeiffer - CMR (mTorr)	Deposition Total Pressure - Vartan - Prestl (mTorr)	Program: Manual, Automatic	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments
YBCO -A	12/09/17	7.9E-07	2	YBCO	3	Si	45	10	10	19	19		RF -2	20 0	0	76	2						2	18	M	0	OR	15 3	93	M				Coating and target cleaning - Turbo pump was stopped to allow that high pressure
YBCO -B	12/09/19	9.7E-07	2	YBCO	3	Si	45	10	10	19	66		RF -2	20 0	1	90	2	18 0	50	0	16 4	2	2	18	F	96	12	14 3	77	M		116		Material coated inside chimney walls peels off: flakes fall down when shutter opens
YBCO -C	12/09/20	5.4E-07	2	YBCO	3	Si	45	10	10	17	69		RF -2	20 0	1	89	2	12 5					5	45	F	90	12	8. 4	4	M	252		Same pressure as YBCO-B but higher gas flow (2.5X)	
YBCO -D	12/09/20	2.0E-07	2	YBCO	3	Si	45	10	10	51	51		RF -2	20 0	1	52	2	12 5					5	45	F	97	42. 5			M				
										94	94		RF -2	20 0	1	51	5	12 5					5	45	F	97	42	5. 9	5	M	118			

Sample name	Date	Base Pressure - Varian - Ion Gauge (Torr) Presl	Gun Number	Target Material	Gun/Target diameter (")	Substrate	Substrate Position (mm)	Target-Substrate Distance (cm)	Substrate Rotation Velocity (rpm)	Temperature Setpoint Value SV (°C)	Temperature Probe Value PV (°C)	Real Sample Temperature (°C)	Mode-Match : RF-2, DC-1	Sputtering FW Power (W)	Reflected Power (W)	Cathode Voltage (V)	Presputtering Time (min)	Sputtering Time (min)	Bias FW Power - sample (W)	Bias Reflected Power (W)	Bias Voltage - sample (V)	Bias Duration (min)	N2 flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Pressure Control: Manual, Throttle, Flow	Throttle Valve (% Closed)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Pfeiffer - CMR (mTorr)	Deposition Total Pressure - Varian - Presl (mTorr)	Program: Manual, Automatic	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments		
YBCO -E	12/09/24	2.9E-07	2	YBCO	3	Si	45	10	10	16	16		RF -2	20	1	48	2						2	18	M	0	OR	14	81	M				Same parameters as YBCO-A but different properties. Turbo pump was stopped to allow that high pressure		
Ti-14	12/11/16	5.9E-07	1	Ti	3	Si back	45	10	10	16	16	83	RF -2	20	0	33		12	5	10	0	25	3	45	M	92	OR	14	80	M		47		Dektak shows a high surface roughness		
											18		RF -2	25	1	26		12	0	10	1	22	30	45		92	13.	9				Material coated inside chimney walls peels off: flakes fall down when shutter opens				
Ti-15	12/11/20	5.8E-07	1	Ti	3	Si	45	10	10	21	21		RF -1						10	0	23	10	45	M	76	5.1				M						
										31	31		RF -2	25	1	23	2	60					2	45		76	5.1				476					New 200sccm Ar mass flow installed and tested with David (replaces old 50sccm)

Sample name	Date	Base Pressure - Varian - Ion Gauge (Torr) Prestl	Gun Number	Target Material	Gun/Target diameter (")	Substrate	Substrate Position (mm)	Target-Substrate Distance (cm)	Substrate Rotation Velocity (rpm)	Temperature Setpoint Value SV (°C)	Temperature Probe Value PV (°C)	Real Sample Temperature (°C)	Mode-Match : RF-2, DC-1	Sputtering FW Power (W)	Reflected Power (W)	Cathode Voltage (V)	Presputtering Time (min)	Sputtering Time (min)	Bias FW Power - sample (W)	Bias Reflected Power (W)	Bias Voltage - sample (V)	Bias Duration (min)	N2 flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Pressure Control: Manual, Throttle, Flow	Throttle Valve (% Closed)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Pfeiffer - CMR (mTorr)	Deposition Total Pressure - Varian - Prestl (mTorr)	Program: Manual, Automatic	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments	
Ti-16	12/11/21	3.5E-07	1	Ti	3	Si	45	10	10	25	35	RF	-1	RF	25	23	23	2	60	10	1	23	10	15	15	15	M	76	15	15	M				
										25	35	RF	-2	RF	25	23	23	2	60	0	0	4	2	15	15	15	M	76	15	15		361			
Ti-17	12/11/22	5.4E-07	1	Ti	3	Si	45	10	10	21	21	RF	-1	RF	25	23	23	2	60	0	0	8	10	14	14	M	0	5	5	M					
										33	33	RF	-2	RF	25	23	23	2	60	0	0	2	2	14	14	M	0	5.1	5.5		471				
Ti-18	12/11/22	2.9E-07	1	Ti	3	Si	45	10	10	36	36	RF	-1	RF	40	28	28	2	60	0	0	0	2	45	45	M	75	5	5	M					
										45	45	RF	-2	RF	40	28	28	2	60	0	0	0	2	45	45	M	75	5	5		839				
Plasma Etch	12/11/28	3.0E-07		Substrates		SiN-OF Ti	45	Non	10	15	15	RF	-1	RF	25	26	26	0	0	0	0	0	0	45	45	M	87	10	10	M					
Plasma Etch				below						30	30	RF	-1	RF	25	22	22	20	20	0	0	9	20	45	45	M	87	10	10	M					
Plasma Etch										91	91	RF	-1	RF	25	21	21	80	80	0	2	2	45	45	M	87	10	11	M						
Si-00				Si-00																												237			
Ti-16				Ti-16																												39			
Ti-17				Ti-17																												21			
Ti-18				Ti-18																												22			
SiN-OF				SiN-OF																												242			
YBCO-F	12/12/07	7.4E-08	2	YBCO	3	Si	45	10	10	19	19	RF	-1	RF	20	11	11	4	4	0	1	23	5	45	45	M	85	10	10	M					
										20	20	RF	-2	RF	20	0	0	2	2	0	0	3	5	45	45	M	74	5	5	M					
										70	70	RF	-2	RF	20	0	0	12	0	0	0	0	5	45	45	M	74	5	5	M			250		

Sample name	Date	Base Pressure - Varian - Ion Gauge (Torr) Presl	Gun Number	Target Material	Gun/Target diameter (")	Substrate	Substrate Position (mm)	Target→Substrate Distance (cm)	Substrate Rotation Velocity (rpm)	Temperature Setpoint Value SV (°C)	Temperature Probe Value PV (°C)	Real Sample Temperature (°C)	Mode-Match : RF-2, DC-1	Sputtering FW Power (W)	Reflected Power (W)	Cathode Voltage (V)	Presputtering Time (min)	Sputtering Time (min)	Bias FW Power - sample (W)	Bias Reflected Power (W)	Bias Voltage - sample (V)	Bias Duration (min)	N2 flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Pressure Control: Manual, Throttle, Flow	Throttle Valve (% Closed)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Pfeiffer - CMR (mTorr)	Deposition Total Pressure - Varian - Presl (mTorr)	Program: Manual, Automatic	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments		
YBCO -J	12/12/12	8.0E-08	2	YBCO	3	Si	45	10	10	19	19		RF -1							10	1	20	2			5	45	M	84	10	7.	M				roughness of the coating
										19	19		RF -2	20	0	78	4								5	45	M	58	2.5	3.1	3.	M				
										30	30		RF -2	20	0	10		41							5	45	M	58	2.5	3.1	5.	M				Deposition ok - I left after 30 min
																		48						5	45	M	58	2.5	3.1	5.	M	70			Deposition stopped (target bias nulled and Reflected/Fw power rose/dropped to 93W, Plasma off) for no obvious reason after a total of 41min. I noticed this 48min later and technically shut off the RF2 generator	
	12/12/21																																		RF1&2 not working but DC-1 ok! DEBUG.	

Sample name	Date	Base Pressure - Varian - Ion Gauge (Torr) Presl	Gun Number	Target Material	Gun/Target diameter (")	Substrate	Substrate Position (mm)	Target-Substrate Distance (cm)	Substrate Rotation Velocity (rpm)	Temperature Setpoint Value SV (°C)	Temperature Probe Value PV (°C)	Real Sample Temperature (°C)	Mode-Match : RF-2, DC-1	Sputtering FW Power (W)	Reflected Power (W)	Cathode Voltage (V)	Presputtering Time (min)	Sputtering Time (min)	Bias FW Power - sample (W)	Bias Voltage - sample (V)	Bias Duration (min)	N2 flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Pressure Control: Manual, Throttle, Flow	Throttle Valve (% Closed)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Pfeiffer - CMR (mTorr)	Deposition Total Pressure - Varian - Presl (mTorr)	Program: Manual, Automatic	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments	
Bolo9 Ti	13/01/07	2.3E-07		Bolo9			45	None	10	15	15	RF -1	40	1	29	28	17	9	80	0	14	1		65	M	95	29.2	10	13	M				Manual Matching from high values works awhile. Needs starting pressure 20-30mTorr
										16	16	RF -1	40	2	29	28			10	0	14	20	45	M	87	10	10	8	M				8nm Ti and 48nm Si etched	
			1	Ti	3	Bolo9	45	10	10	25	76	RF -2	40	0	40	2	29	17	9	10	0	1	45	M	77	5	5	5	M	250	8		2508nm =48nm (Si etched) + 2460nm measured with dektak on the Si holder	
Bolo2 Ti & Bolo5 Ti	13/01/11	4.7E-08		Bolo2 & Bolo5			45	None	10	16	16	RF -2	20	0	12	12		5	20	0		65	M	76	7.3	5.9	5.9	M				Target cleaning, At 5mTorr Bias drops from 132V to 0V after 2min so I increase the pressure to restart the plasma		
							45	None	10	15	15	RF -1							10	0	20	1	65	M	95	30.6	13	M						

Sample name	Date	Base Pressure - Varian - Ion Gauge (Torr) Presl	Gun Number	Target Material	Gun/Target diameter (")	Substrate	Substrate Position (mm)	Target→Substrate Distance (cm)	Substrate Rotation Velocity (rpm)	Temperature Setpoint Value SV (°C)	Temperature Probe Value PV (°C)	Real Sample Temperature (°C)	Mode-Match : RF-2, DC-1	Sputtering FW Power (W)	Reflected Power (W)	Cathode Voltage (V)	Presputtering Time (min)	Sputtering Time (min)	Bias FW Power - sample (W)	Bias Reflected Power (W)	Bias Voltage - sample (V)	Bias Duration (min)	N2 flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Pressure Control: Manual, Throttle, Flow	Throttle Valve (% Closed)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Pfeiffer - CMR (mTorr)	Deposition Total Pressure - Varian - Presl (mTorr)	Program: Manual, Automatic	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments		
Si-01_pe	13/01/15	3.0E-07		Si		Si	45	None	10	16			RF-1							10	0	24	0			45	M	87	9.9		7.1	M				quality. I replace the previous one (which reveals to be fissured) with this on Gun 2
Plasma Etch										60			RF-1							10	1	6	10			45	M	87	9.8	10.2	7	M	0!		Dektak : less than 9nm Si etched with that low voltage. Recent Ti depositions probably created a thin film short (Resistance on substrate holder connector is 1.17k ohms)	
Time tests	13/01/16	2.0E-07		None		Si	45	None	10	16															0	M	0	1.8	1.6	1.8	M				To verify the correspondance between Stopwatch Time and Log-File Time	
																		20							50	M	0	1.8	1.6	1.8	M					

Sample name	Date	Base Pressure - Varian - Ion Gauge (Torr) Presl	Gun Number	Target Material	Gun/Target diameter (")	Substrate	Substrate Position (mm)	Target→Substrate Distance (cm)	Substrate Rotation Velocity (rpm)	Temperature Setpoint Value SV (°C)	Temperature Probe Value PV (°C)	Real Sample Temperature (°C)	Mode-Match : RF-2, DC-1	Sputtering FW Power (W)	Reflected Power (W)	Cathode Voltage (V)	Presputtering Time (min)	Sputtering Time (min)	Bias FW Power - sample (W)	Bias Reflected Power (W)	Bias Voltage - sample (V)	Bias Duration (min)	N2 flow (sccm)	O2 flow (sccm)	Ar flow (sccm)	Pressure Control: Manual, Throttle, Flow	Throttle Valve (% Closed)	Deposition Total Pressure - MKS - Baratron (mTorr)	Deposition Total Pressure - Pfeiffer - CMR (mTorr)	Deposition Total Pressure - Varian - Presl (mTorr)	Program: Manual, Automatic	Thickness (nm) Dektak	Thickness (nm) Ellipsometry	Comments		
Si-02_pe	13/01/16	1.3E-05		Si		Si	45	Non e	10	18			RF -1							100	39	239	0			45	M	87	10.3		8.4	M				Resistance on substrate holder connector is 0,911k_ohm s. Cleaning of substrate holder (IPA, Acetone, dirt suction with a vacuum, N2 blow, wipes) yields 620k ohms
Plasma Etch										33			RF -1							100	16	216	25			45	M	87	9.9		8.1	M				

Annex 2: Resistivity/Temperature data for YBCO samples

Measurements performed using the Signatone Pro-4 Manual Four Point Probe

