SPIN Equipments – Thin Film Deposition

Thin Film Deposition					
	Name	Picture	Description	Site	Responsible
1	MODA – Surface Analysis Chamber		The MODA surface Analysis chamber is equipped with several experimental techniques aimed to the study of the chemical, structural and electronic properties of thin films and single crystals. A manipulator with independent 5 degrees of freedom allows XPS, UPS analysis of the samples in a temperature range from 300K to 1200K (upgradable 20K-1200K). The chamber has been designed to be further implemented with other surface preparation and characterization techniques, like ion sputtering and photoelectron diffraction. the Analysis chamber is also equipped with a SPM microscope and an SPA-LEED instruments as described below:	NA	
1a	MODA: Pulsed Laser Deposition chamber	PLD-MBE Fig: Top view of the deposition chamber and of the two diagnostic tools used for monitoring the plume expansion (ICCD camera) and the film growth (RHEED)	UHV chamber for Pulsed Laser Deposition with in-situ control of the growth process by high pressure Reflection High Energy Electron Diffraction (RHEED). Heterostructures and superlattices can be grown thanks to a multi target carrousel where up to six different targets can be mounted. The deposition is performed with an KrF excimer laser (Compex Pro 205) at 248 nm wavelength, delivering laser pulses of 25 ns duration, maximum energy 800mJ. The substrate is placed on a heater which can heat up to 850°C, also in Oxygen atmosphere. The final vacuum of about 10^{-9} mbar is obtained by a turbopump. The system is also equipped with two load-lock chambers to transfer the substrates and the targets without breaking the vacuum conditions. The samples can be in-situ transferred in UHV conditions to the analysis chamber for the surface characterizations by XPS, UPS, SPA-LEED, STM, AFM. The ICCD camera can be also installed to study the plume expansion dynamics.	NA	Aruta

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1b	UHV XPS/UPS (MODA)	XPS/UPS	X-ray Photoelectron Spectroscopy (XPS) measurements are performed by employing a dual anode x-ray source DAR400 Omicron. X-ray energies are 1486.6eV (Mg K) and 1253.6 eV (Al K). Perpendicular and shallow angle configurations, the latter being most sensitive to the surface chemical composition can be used. The photoemitted electrons are detected by a 5 channel hemispherical spectrometer. Using the same detector system but a UV lamp SPEC UVS 10/35 for the radiation, Ultraviolet Photoelectron Spectroscopy (UPS) can be also performed.	NA	Aruta
1c	UHV STM/AFM plus Surface Analysis Chamber (MODA)	VT_AFM Fig.: (a) a close view of the VT-AFM instrument and (b) 4x1reconstruction of a TiO2 anatase atomic row of a thin film deposited in situ by PLD. (M. Radovic et al. unpublished.)	The UHV Omicron VT-AFM system is designed to operate as scanning tunneling microscope, atomic force microscope, and hybrid scanning probe microscopes, in a temperature range between 300K-1000K (20K-1000K upgradable). This instrument is especially intended to the characterization of clean crystalline surfaces, in particular thin films prepared in-situ either by PLD or other deposition techniques, or single crystals (cleaved or annealed). The max scan area is 8x8 μm^2 with a spatial resolution below 0.1 nm. The vertical resolution is 0.01nm. The VT-AFM is capable to operate in a variety of spectroscopic modes: I-V and G(V) (conductance) spectroscopy in STM and contact AFM modes Electrostatic force microscopy Magnetic force microscopy Kelvin probe microscopy Piezoforce microscopy The UHV ($P<10^{-11}$mbar) surface anaysis chamber is equipped a manipulator having 5 degrees of freedom, heatable up to 1000°C.	NA	Salluzzo

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1d	UHV SPA-LEED (MODA)	SPA-LEED $33.7° \sqrt{13} \times \sqrt{13}$ SPA-LEED pattern reconstruction of the surface of an homoepitaxial $SrTiO_3$ thin film deposited in-situ by PLD on an STO single crystal. (courtesy by M. Radovic et al. unpublished)	The Spot Profile Analysis Low Energy Electron Diffraction instrument (SPA-LEED) is a special LEED designed to allow high resolution reciprocal space mapping of ordered surfaces. This LEED is used for the thorough analysis of defect structures on single crystal surfaces. The technique enables precise quantitative analysis of lateral and vertical lattice constants, terrace/islands size and height distribution, ordering parameters in phase transitions etc. The main part of the SPA LEED is an octopole which enables the scanning of the diffracted beam over a detection assembly, thus improving the signal to noise ratio and resolution compared to conventional, screen and camera based systems.	NA	Salluzzo
2	UHV Sputtering system for Josephson junctions fabrication	Prototype	UHV sputtering system with one cylindrical and two planar magnetrons (deposition of YBaCuO, SrTiO, MgO, CeO, Au)	NA	Tafuri

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3	Multi Chamber sputtering deposition system	Multi chamber sputtering	The Multi-chamber UHV sputtering system is designed for the growth of very thin oxide thin films on area up to 2 inches. It is equipped by a chamber dedicated to the growth of HTS cuprate superconductors (NdBCO, YBCO, LSCO), a chamber dedicated to the deposition of ferroectric and multiferroic thin films ($BiMnO_3$, $SrMnO_3$) and by a chamber for the in-situ growth of metal contacts (joule evaporator and sputtering) with suitable geometry by shadow mask. All-in-situ field effect prototipes and stacked HTS/dielectric/metal structure can be realized in this system.	NA	Salluzzo
4	Sputtering system	Home made prototype.	Three chambers ultra-high vacuum system: one of these, equipped with three DC and RF 2.0" sputtering magnetrons, is connected to the other two, both with independent access. The second chamber is equipped with an etching ion gun and a self-made substrate cooling system based on N_2 gas flow, while the third one has a 2" DC and RF sputtering magnetron and a substrate holder with a distance that can be changed without breaking vacuum.	NA	Parlato

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5	MAPLE system	Custom	MAPLE (Matrix Assisted Pulsed Laser Evaporation) system for biomaterials and polymeric thin film deposition composed by a vacuum chamber (pressure down to 10⁻⁷mbar) and a Q-switched Nd:YAG pulsed (7ns, 0.5-10Hz) laser operating in IR (1064nm, 1.17eV, 500mJ/pulse) VIS (532nm, 2.33eV, 100mJ/pulse) or UV (355nm, 3.49eV, 90mJ/pulse) with in place target refrigeration (liquid nitrogen, 77K) and substrate heating (up to ~470K).	NA	Bloisi
6	Deposition system for hybrid (organic/inorganic) materials and devices		Thin-film deposition system consisting of two deposition chambers connected by a load lock and equipped with a flash evaporation system and 2 knudsen cells allowing deposition of organic material and metals.	NA	Cassinese

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7	PLD system for nanoparticles an thin films deposition (Fs-PLD)		PLD system for ultrafast laser ablation, nanoparticle generation and nanoparticle-assembled film deposition. The laser spourse is a Light Conversion Nd:glass Twinkle (3 mJ/1054 nm/850 fs; 1 mJ/527 nm/300 fs; 0.25mJ/266nm/300 fs). The PLD system is equipped with a vacuum chamber with accessories and feedthroughs.	NA	Wang
8	PLD 300 mJ “multipurpose”		It is an homemade PLD deposition system devoted to the growth of oxide compounds. It consists of a 350 mJ KrF excimer laser (wavelenght 248nm) and a deposition chamber. The system base pressure is 10^{-7} mbar and the deposition can be done at temperature up to 900°C and in oxygen atmosphere up to 10^{0} mbar both using a continuous or a pulsed oxygen flow. The chamber is equipped with a 4 target carousel and prepared for the RHEED monitoring of the growth.	GE	Marré

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9	Deposition system PLD 700 mJ “oxides”		Pulsed laser deposition system Pressure down to 10-9 mBar and substrate temperature up to 900°C also in O2 atmosphere. Fast entry system for sample loading, differentially pumped RHEED working up to 10-2Mbar O2; Pulsed gas inlet synchronized with laser pulses; 6 targets; HV sample manipulation by wooblestick. The system is specifically designed for oxide thin films deposition and is interfaced with a cryogenic STM by a HV transfer chamber.	GE	Bellingeri
10	Deposition system PLD 700 mJ “metals”		Pulsed laser deposition system Pressure down to 10-11 mBar and up to 10-5 mBar O2; substrate temperature up to 1200°C. Fast entry system for sample loading, RHEED; 4 targets; UHV sample manipulation by wooblestick. The system is specifically designed for intermetallic thin films deposition and is interfaced with a cryogenic STM by a UHV transfer chamber.	GE	Bellingeri

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11	Experimental set-up for the deposition of ultrathin metallic films by MBE	Homemade prototype	UHV chamber equipped with: electron-beam deposition sources for the growth of ultrathin metallic films; ion gun for sputter cleaning; UHV-compatible 5 degree-of-freedom sample manipulator; variable temperature sample holder (130–800 K). The UHV chamber also features an Auger electron spectrometer (AES) and a low-energy electron diffraction (LEED) set-up.	GE	Moroni
12	HV sputtering system		Deposition system for oxide materials consisting of: 1) CF (UHV) vacuum system , 2) low vacuum, oil free pumping system (1 mbar), 3) high vacuum turbo-molecular pump (10^{-7}mbar) 4) substrate holder heated up to 900°C	SA	Bobba

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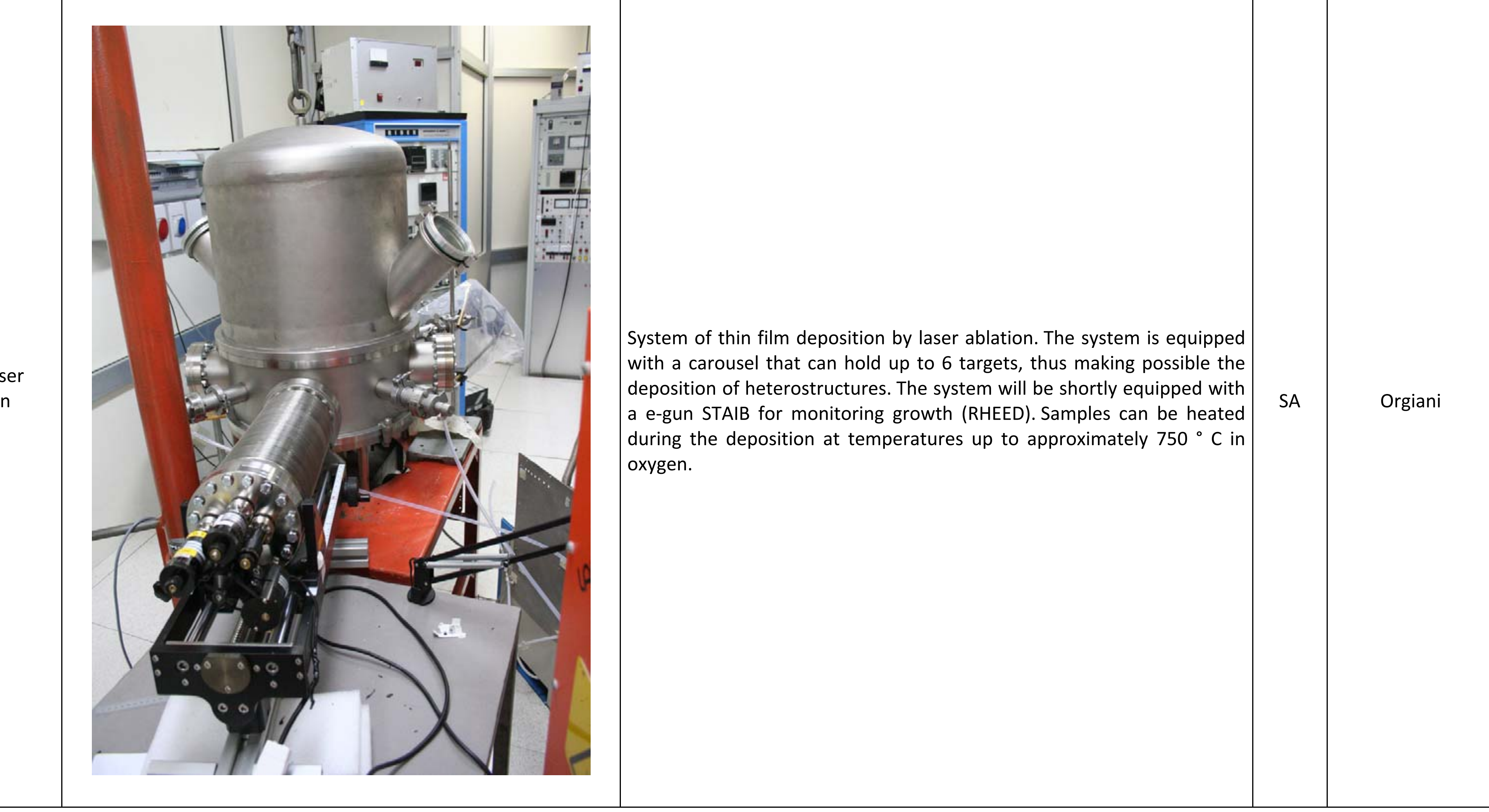
13	Pulsed Laser Deposition system		System of thin film deposition by laser ablation. The system is equipped with a carousel that can hold up to 6 targets, thus making possible the deposition of heterostructures. The system will be shortly equipped with a e-gun STAIB for monitoring growth (RHEED). Samples can be heated during the deposition at temperatures up to approximately 750 ° C in oxygen.	SA	Orgiani

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14	Molecular Beam Epitaxy deposition system	Custom	System for thin film deposition by molecular beam epitaxy. The system consists of a UHV Chamber equipped with different effusive cells inferred (by DCA) to the evaporation of individual materials. The system is equipped with e-gun STAIB for the analysis of in-situ growth (RHEED). It is also equipped with a pre-Chamber for loading the samples without breaking the vacuum conditions in the main Chamber. This last room is also equipped with an indipendent pumping system.	SA	Orgiani
15	Sputtering RF	Custom	Magnetron Rf sputtering (13 MHz, 1.5 KW) with three 6 inch deposition sources and one sputter etch cathode. Cryopumped deposition chamber and turbo-pumped load lock. Used for deposition of superconducting (Nb, Al), insulators (SiO_2), normal (Cu, Mg), and magnetic (Co, Cr, NiFe, CoFe, FeMn) thin films. The load lock is also used for growth of very thin films of Al_2O_3 by thermal oxidation of Al. Used for Ferromagnet-Superconductor devices or nanoscale superconducting devices.	SA	Carapella

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16	Sputtering large area (SGA)		The DC sputtering deposition system is a facility planned to realize highly uniform and high areas (max 3x10cm^2) HTS layers in an O_2 atmosphere. The vacuum line is composed by a two stage apparatus, with a membrane pump for a preliminary vacuum and a turbomolecular pump, directly connected to the chamber through a gate; this permits to reach a base pressure $p_{base} \approx 10^{-6}$ mbar. The system is equipped with an infrared lamps system as a heater which is capable to reach temperatures up to about 900°C.	SA	P.Romano

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17	Sputtering DC for oxidees	Home made prototype	The dc sputter deposition system has been designed for research involving high temperature superconducting compounds and devices based on these materials. In particular this system has been successfully used to fabricate thin films of the $Nd_{2-x}Ce_xCuO_{4-d}$ compound. This sputtering system is provided of: a routable flange with three sputter sources, a substrate heater that can reach temperatures up to 900 °C; an automated system control in order to achieve high reproducible level of processes.	SA	Nigro
18	Three sources UHV sputtering		UHV dc magnetron sputtering equipped with a load-lock chamber. The systems has 3 sources, one especially designed for the fabrication of ferromagnetic materials. The deposition chamber is equipped with a movable protecting shutter driven by a pc controlled step motor, in order to fabricate up to 8 samples in the same deposition run. This solution allows the realization of different layered hybrid structures under identical deposition conditions.	SA	Cirillo

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19	PLD thin films deposition system with in-situ RHEED diagnostics		It is a system equipped with an excimer laser. The apparatus has a multitarget system for oxide heterostructures and superlattices deposition. A Reflection High Energy Electron Diffraction (RHEED) system allows the in-situ growth diagnostics. It is also possible to use an oxygen deposition atmosphere enriched with 12% of ozone.	Roma	Tebano

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20	PLD thin films deposition system ready to be upgraded with in-situ RHEED diagnostics		It is a system equipped with an excimer laser. The apparatus has a multitarget system for oxide heterostructures and superlattices deposition. The system is ready to be upgraded with a Reflection High Energy Electron Diffraction (RHEED) system in order to allow the in-situ growth diagnostics.	Roma	Tebano

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21	PLD thin films deposition system		It is a system equipped with an excimer laser. The apparatus has a multitarget system for oxide heterostructures and superlattices deposition.	Roma	Tebano