TECHNICAL SPECIFICATIONS

FOR THE SUPPLY OF
AN 'AUTOMATED FLIP CHIP EQUIPMENT WITH SUB MICRON ACCURACY FOR OPTOELECTRONIC DEVICES'
FOR
SCUOLA SUPERIORE SANT'ANNA

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Index

INTRODUCTION

For the packaging of optoelectronic and silicon photonics devices, one of the most important technologies is the passive integration of semiconductor optical diodes on silicon substrates (particularly in wafer form).
Specifically, for silicon photonics applications it is important to have the capacity to integrate laser diode, in single or arrayed form, pin diodes, drivers and TIA in chip or arrayed form over substrates or wafers.
Such hybridization capability is in fact recognized as fundamental in optoelectronic applications and this is only possible through die-attachment equipment specifically designed for the tight optical system specs.
In fact, one of the major specificity of the optoelectronics applications respect to electronics is related to the necessity, for such types of technologies, to be able to reduce alignment and attachment tolerances to micron or submicron level after the components are soldered. The best technology that can reach such kind of tolerances using passive alignment is the so called flip-chip and we're looking to a flip chip (or flip chip related) machine that can fulfill such kind of requirements at industrial level for the prototipation up to the small production of completed soldered parts at wafer level.
In terms of processes, the soldering can be obtained with different methods and technologies. The laser technology is by far the preferred one for us, especially for the speed and the possibility to solder locally a chip without affecting the soldering already done on other components, especially at wafer level. For this reason, already installed laser soldering technology in the requested equipment is mandatory.
At the same time, heating soldering technology is also important for some material applications and it is requested as a possible upgrade to the equipment. Special point of merit and proper evaluation will be given in case such heating technology is already installed and offered (with same tolerances accuracy).
Apart from tolerance accuracy (that is the main requirement), it is important to evidence the importance for us of the automation. It is accepted to load the parts inside the machine manually (for example laser diodes on waffle pack and wafer as substrate), but all the process has to be automated and vision assisted. It means to have patter recognition system, proper interface software for process programming and set up, simplified calibration procedures, equipment stability and so on. Mechanical fixtures of course have to be compatible with optoelectronic component fragile materials.
It will be a point of merit as well to have a machine that, apart of flip chip technology as described above, can also eventually operate on more standard die attachment procedures (at higher speed and relaxed tolerances).
It ismandatorythe possibility to upgrade the machine with a bond head for active alignment of subassemblies, specifically laser micro-packaged devices (LAMP style) on grating couplers.
Again, in the case such bond head is already installed and offered with the machine, it will be an important point of merit.
Same approach will be followed for the epoxy processing, including dispensing and curing. Upgrade option is mandatory, point of merit will be given is such item is already installed and offered with the machine.
And finally, to be able to be competitive on the market, as mentioned it is important to have the equipment able to handle wafers and not only single substrates. In such sense an 8-inch wafer handling is the best choice, looking at the market necessities. But as well we'd like to have equipment that can be upgraded to 12 inches in the future. It means that we'll properly give point of

merit to the offered equipment with the proper space and the proper axis work range to be able to handle in the future 12-inch wafers.

We summarize here the main basic mandatory requirements:

- Micron or submicron tolerances post bonding
- Laser soldering system
- Upgrade machine to heating soldering
- Upgrade machine to epoxy processing
- Automation for complete process both for prototipation and small/medium production
- 8-inch wafer compatibility
- Proper adaptor to handle smaller substrates
- Possibility to upgrade the bond head to allow active alignment of laser micropackages (LAMP style) on grating couplers
- System Speed
- Possibility to locally solder multiple chips on substrate/wafer, one by one with no thermal interference between them (distance between chips 1mm or less)
- Eutectic gold/tin 80/20 soldering
- Bonding force (same tolerance accuracy) more than 1,5 kg
- Patter recognition system and complete vision assisted process
- Programmable Interface Software for process development and production
- Capacity to handle different sizes of optoelectronic devices in die or arrayed form

1. Technical specifications: minimum requirements

1.1 Hardware configuration

- Substrate carrier for 8” wafer
- Substrate adaptor (dimensions to be agreed, see 1.2)
- Optical chip dimensions: capability from 0,25x0,25 mm to 10x10 mm
- Placement Accuracy has to be +/- 1 microns or less at 3sigma
- Laser soldering technology and system
- Possibility to upgrade to heating soldering technology and relative processes
- Possibility to upgrade to epoxy processing
- Granite based platform
- Motion controlling system
- Bonding head to be designed to obtain and keep mentioned accuracy up to minimum1,5Kg applied force during process
- Possibility to upgrade to bond head for active alignment of laser micropackages to grating couplers
- Eutectic bonding soldering process, gold/tin 80/20
- Local Soldering
- Camera systems for correlations and vision assistance
- Pattern recognition system (Cognex or similar)
- Autofocus capability
- High resolution stages for critical movements, resolution expected <= 0.1 microns

- Complete software: graphical user interface, windows operating system (or equally performing)
- Waffle pack/Chip tray
- Bond head tools

1.2 Process configuration

- Automatic die attachment flip chip of laser diode on gold/tin 80/20% plated single substrate, post bonding accuracy 1 micron or less (device and substrates supplied by Scuola Superiore Sant'Anna)
- Same as above but using two laser diodes at the proper distance between them on the single substrate, with the purpose to show the local soldering of one diode without affecting the soldering of the previous one.
- Automatic multiple die attachment flip chip of laser diode on gold/tin 80/20% plated wafer parts (it means a piece of wafer with multiple repeated substrates), post bonding accuracy 1 micron or less for all diodes (devices and wafer parts supplied by Scuola Superiore Sant'Anna)
- Above processes to be automated (manual loading excluded). Complete single diode attachment process cycle below 4 minutes. Cycle is defined as: pick up chip, alignment with automatic pattern recognition, complete soldering cycle.

1.3 Conditions

- Conformity to CE standard and certification
- Availability of spare parts guaranteed for minimum 10 years
- Warranty 1 year after "acceptance" (see 3.2)
- Shipment and installation included to:
  Scuola Superiore Sant'Anna (TeCIPInstitute)
  Via Giuseppe Moruzzi 1
  56127 Pisa (Italy)

1.4 Additional Agreement

The winner will have the following benefits if it will apply a minimum discount of 12% respect to the tender starting price:

- Free use of the lab as show room for 10 days/year for a total of two years after equipment installation, days to be agreed with the School with minimum two weeks advance notice
- Free use of the lab for 10 additional days/year for a total of two years (days to be agreed with the School with minimum two weeks advance notice) with the following purposes:
  - Testing/assembly/prototyping on devices that are of interest for the winner,
  - Utilization by the winner of the equipment for improving performances or test upgrades or test new processes on the machine, granted compatibility.

2. Technical specifications: evaluable features

2.1 Hardware configuration

- Heating soldering system for eutectic bonding
- Post Bond Inspection
- Active alignment Bond Head for Laser Micropackage (LAMP style)
- Machine upgradable to 12-inch wafers. Note that in case the 12-inches wafer chuck and capability is already installed, it is intended that it is possible to use 8 inches wafers (with included adaptors) as well 12- inches wafers.
- Additional adaptors or tools
- Epoxy Processing

2.2 Process

- Gold/Tin soldering process cycle reduced

2.3Other

- Consumable spare parts kit for yearly maintenance
- Open Software architecture to allow further process changes and integration of third party devices or metrology

3. Installation, acceptance, documents

3.1 Installation and equipment move-in

1. Supplier must check in advance before delivery for the correct placement and connection, facilities presence, flow and pressure value.
2. Supplier is in charge for the move-in of the equipment inside the Inphotec Area once delivered (see Appendix 4.3)
3. Scuola Superiore Sant'Anna, is in charge for the hook-up

3.2 Acceptance

Installation and commissioning, followed by process start-up with demonstration of defined process specification must be performed onsite by the Supplier.

3.3Documents

Supplier must:

1. Detail configuration of the equipment and list of parts and components
2. Detail all technical specification as for the minimum requirements
3. Deliver layout of installation and the list of the facilities required for a proper functioning of the tool.
4. Deliver process data for gold/tin 80/20 soldering
5. Deliver procedures for standard operations and maintenance.
6. Deliver safety instructions

7. Deliver the following documents/information in relation to the upgradable parts requested (see inside table 4.2):
    - Upgradable Active Alignment Bond Head: active alignment is intended for active alignment on grating couplers of laser micropackages similar as Luxtera LAMP, documentation is needed on the availability of the head and basic information on the head, demonstration that the upgrade is possible on the offered equipment,
    - Upgradable to 12-inch wafers: detailed documentation on the fitting and compatibility of the offered equipment for a future 12-inch wafer upgrade. As already mentioned, if the 12-inches wafer chuck is already installed, it is intended that it is possible to use 8 inches wafers (with adaptors included in the offer) as well 12- inches wafers. In this case it fulfills the minimum basic requirement and it will have points of merit.
    - Upgradable Heating Soldering: documentation and draws on the heating module, chuck, bond head and demonstration that the upgrade is possible on the offered equipment. It is intended that it is possible to achieve same kind of post soldering attachment accuracy (in any case not worse than +/- 1,5 microns).
    - Upgradable epoxy processing: it is intended for dispensing and curing UV epoxy (thermal curing is intended possible if heating chuck upgrade is installed, see point above). Draws, documentation of the relative parts are requested to demonstrate that the upgrade is possible on the offered machine
    - Note: if some of the four items mentioned above are already included and will bealready installed in the machine, supplier must clearly illustrate it in the machine technical presentation and fullrelative documentation
8. CE conformity declaration
9. Describe after sales service and support solution.

The compliance of the equipment to the minimum requirements and evaluable features must be evident in the documentation (1-9).

4. Appendix

4.1 Summary table of minimum requirements

The compliance of the equipment to the minimum requirements must be evident in the documentation(paragraph 3.3).

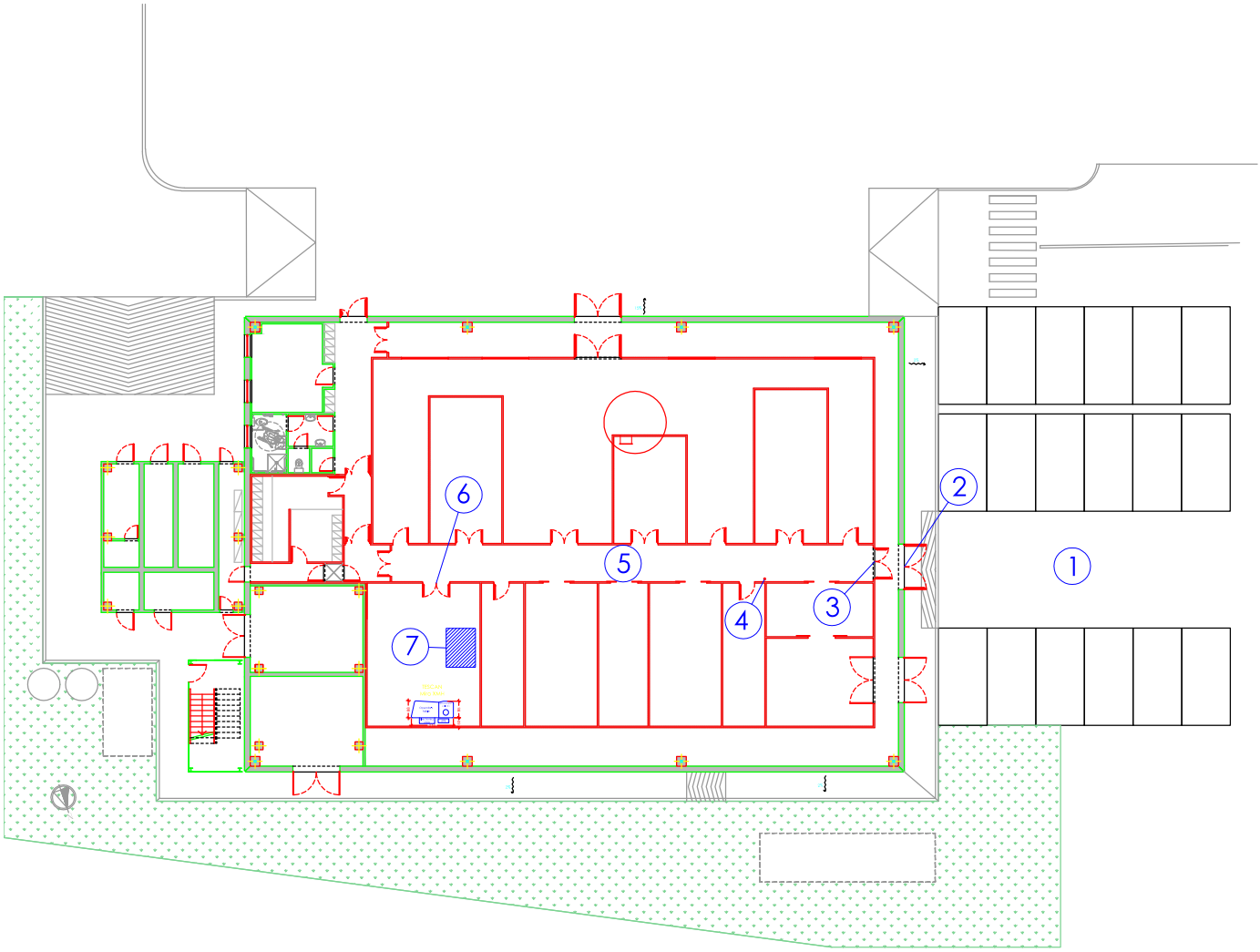
Summary Specifications			
Parameter	Target Specs	Units	Note
Substrate carrier 8" Silicon wafer	yes		
Adaptor for square substrate	yes		Substrate dimensions to be agreed
Laser soldering technology and system	yes		
Upgradable with heating chuck and heating processes	yes		
Upgradable with epoxy processing	yes		
Possibility to upgrade with bond head for active alignment of laser micropackage (LAMP style) on grating couplers	yes		
Granite based platform	yes		
Automatic calibration	yes		
Post bonding accuracy	≤1	um	
Bonding force	up to 1,5	Kg	minimum
Resolution of high precision stages	0,1	um	
Pattern recognition	yes		
Chip dimensions capability	0,25x0,25 to 10x10 or more	mm	
Motion Controlling System	yes		
Eutectic solder process availability	yes		Au/Sn 80/20
Cycle time (laser diode soldered on substrate- see 1.2 paragraph))	4	min	Max time
Camera system for alignment and correlations	yes		
Complete software for automatic processes, proper user interface for programming processes, possibility to have log files and trace components	yes		
Waffle pack and/or chip trays	yes		
Basic bonding tools	yes		
Conformity	CE mark		
Availability of spare parts	> 10	years	
Warranty	1	year	
Shipment and installation (except for hook up)	included		

4.2 Summary table of evaluable features

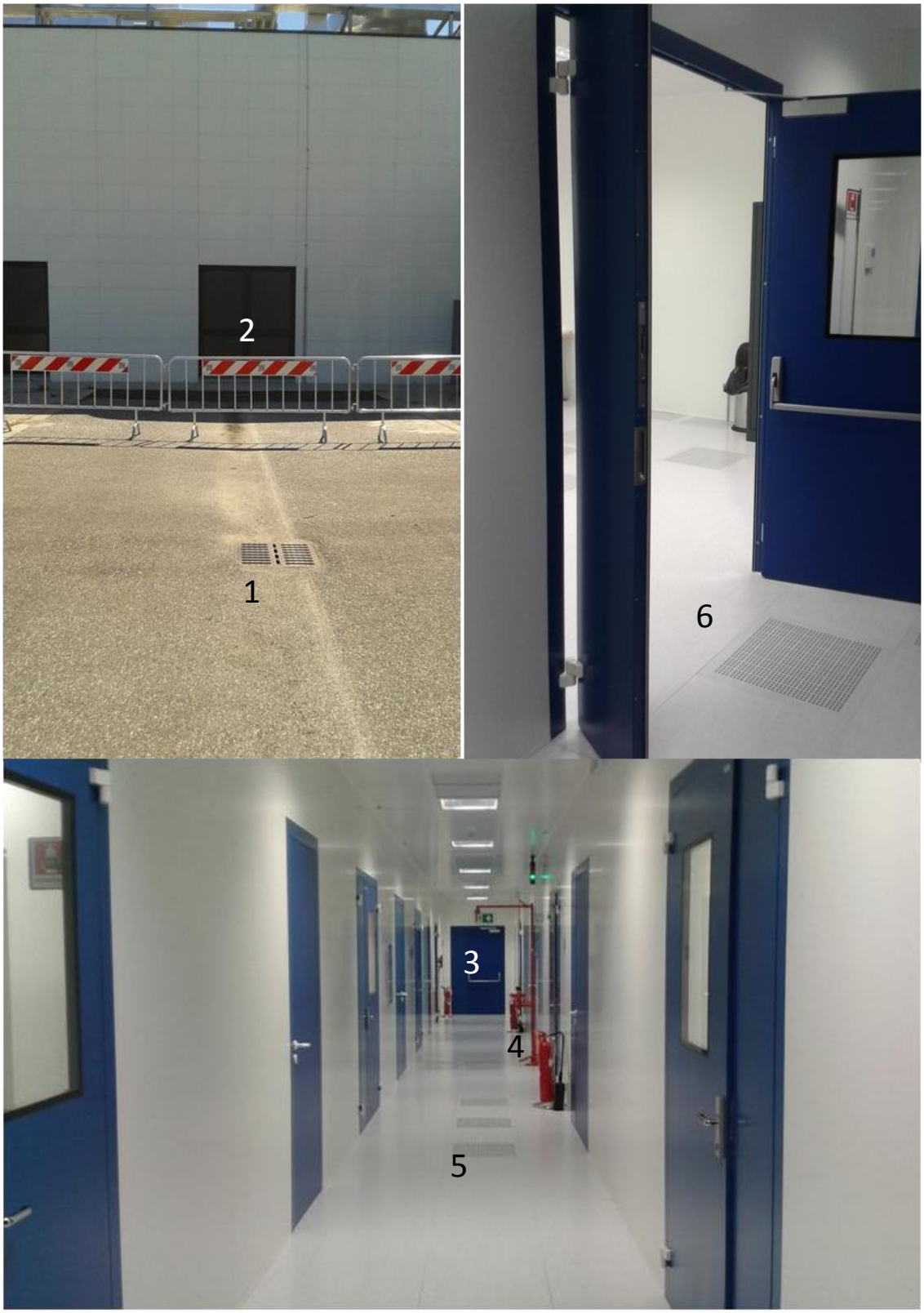
The compliance of the equipment to the technical specification assessable as improvements must be evident in the documentation (paragraph 3.3).

Summary Evaluable Features (quantitative evaluation)			
Item	**Parameter**	**Evaluation system**	**Maxpoints**
Configuration			
A.1	Heating Soldering Process: Chuck, Head and Technology	If the parameter is absent = 0 If the parameter is present = max points	23
A.2	Post bond inspection: to measure/inspect final obtained tolerances	If the parameter is absent = 0 If the parameter is present = max points	8
A.3	Active Alignment Bond Head for Laser Micropackage (LAMP style)	If the parameter is absent = 0 If the parameter is present = max points	10
A.4	Additional substrate adaptors or tools	If the parameter is absent = 0 If the parameter is present = max points	2
A.5	Upgradable to 12Inch wafers	If the upgrade is NOT possible = 0 If the upgrade is possible= 5 points If 12inch wafer chuck already installed in the machine = max points	10
A.6	Epoxy processing: including epoxy dispensing and curing	If the parameter is absent = 0 If the parameter is present = max points	8
Process			
A.8	Gold/Tin soldering complete process cycle reduction with bonding tolerances+/- 1 micron (respect to the 4 minutes minimum)	60 seconds less = 1 90 seconds less =2 120 seconds less =4	4
Other			
B.1	Consumable spare parts kit for yearly ordinary maintenance	If the parameter is absent = 0 If the parameter is present = max points	2
B.2	Open Software architecture to allow further process changes and integration of third party devices or metrology	If the parameter is absent = 0 If the parameter is present = max points	3
		MAX TECHNICAL POINTS	70

4.3Inphotec Area Details for Move-In



1. Unloading area. Confined and accessible by lorry.
2. Door #1. 15 cm step to climb. Width 2.3 m.
3. Door #2. Width 1.6 m.
4. Safety basin and shower, removable. Width after basin removal 1.7 m.
5. Corridor. Width 1.9 m.
6. Door #3. Width 1.45 m. Height 2.2 m
7. Position of the machine.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