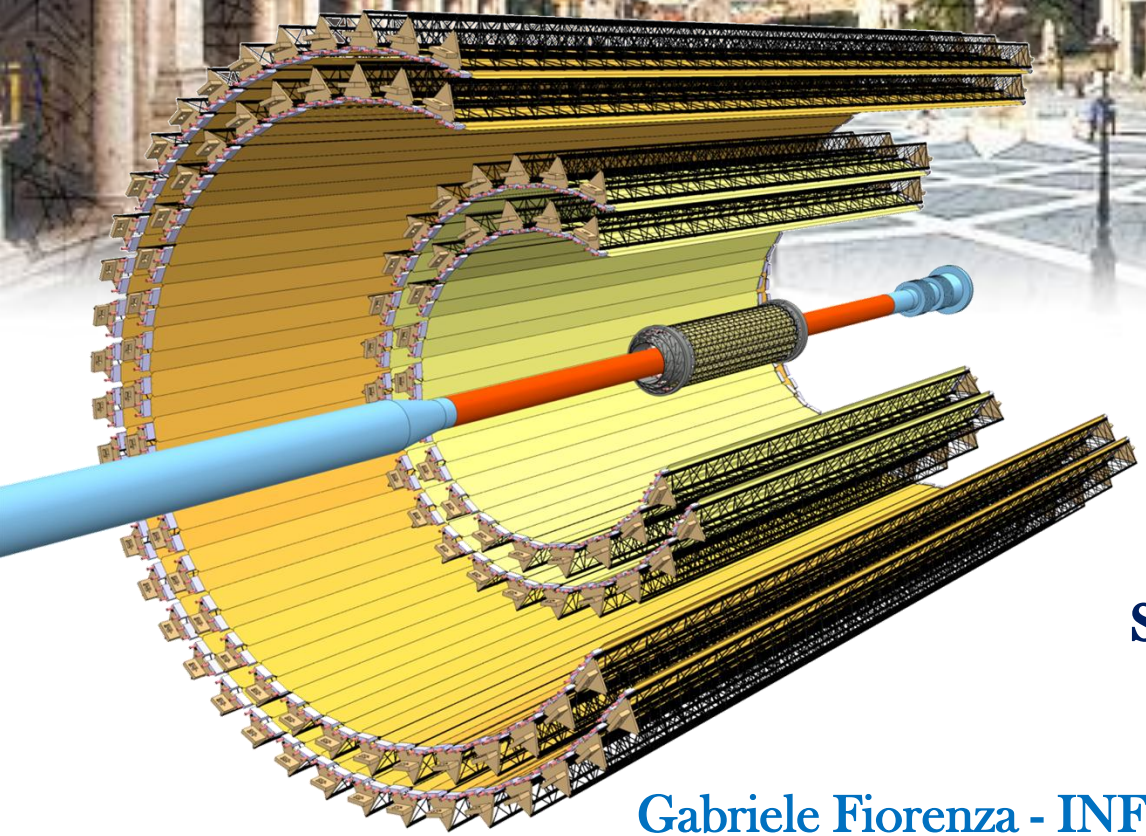
INFN
Istituto Nazionale di Fisica Nucleare

ALICE

101° CONGRESSO DELLA SOCIETÀ ITALIANA DI FISICA



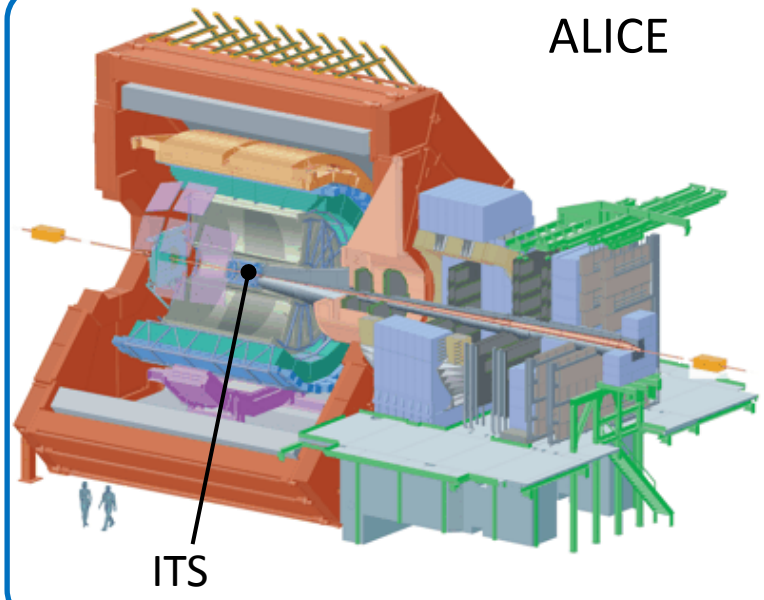
Micro-saldatura laser per il tracciatore interno a pixel di silicio dell'esperimento ALICE ad LHC

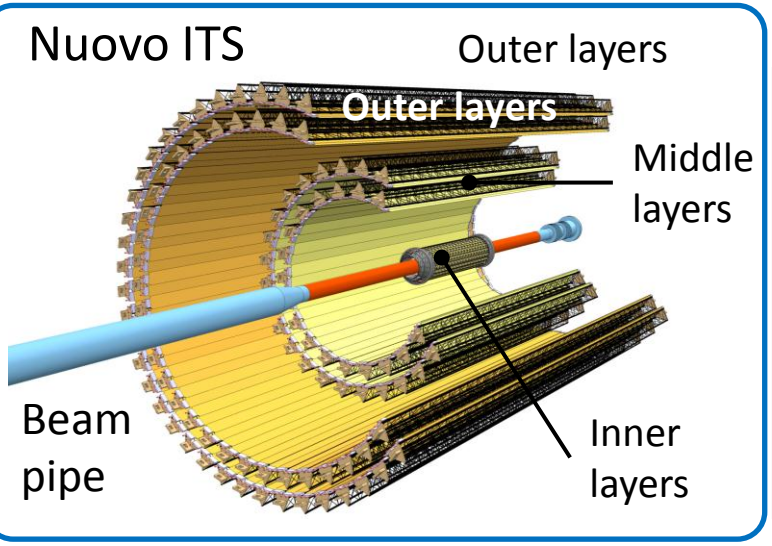
Gabriele Fiorenza - INFN - Sez. di Bari

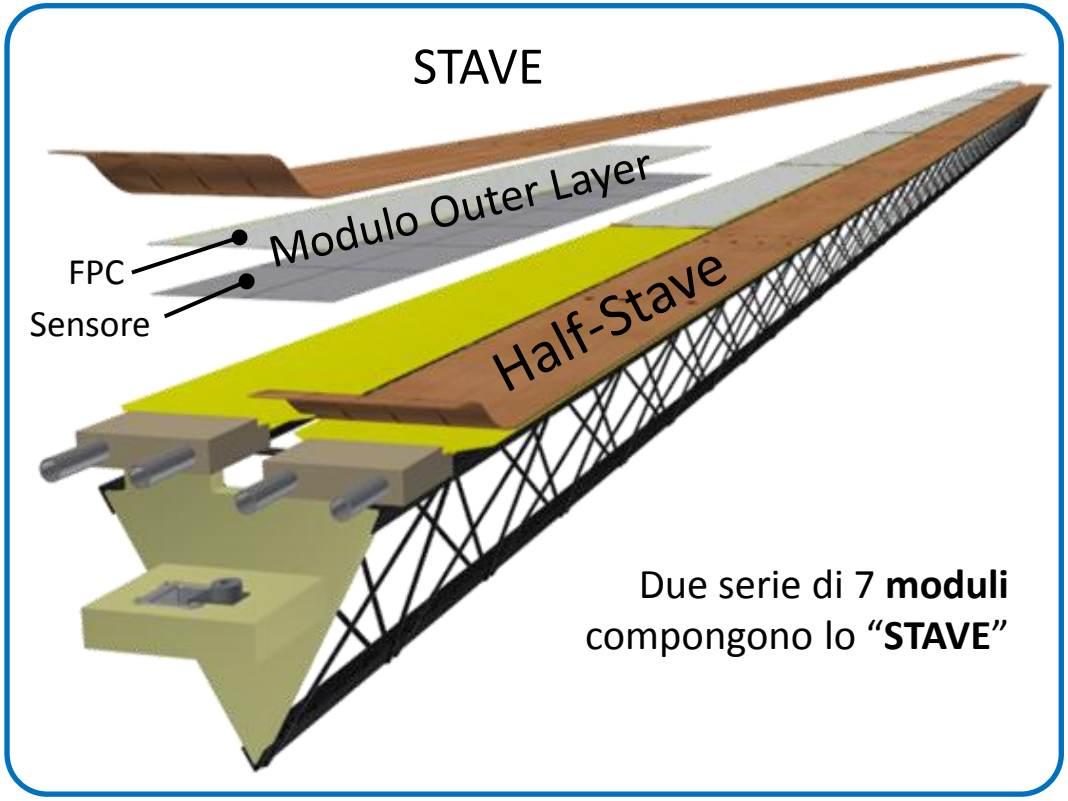
ITS Upgrade

Upgrade di ALICE previsto per il LS2 (2019-2020) e comprende l'aggiornamento dell'Inner Tracking System (ITS)

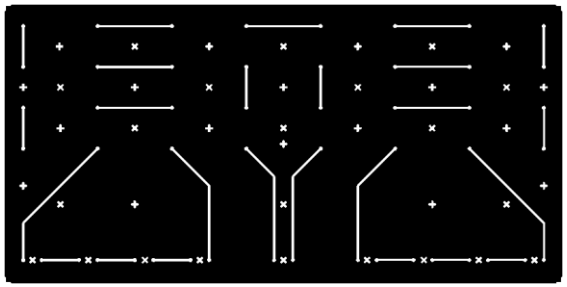
7 layers di sensori al pixel di silicio dello spessore di 50 μm



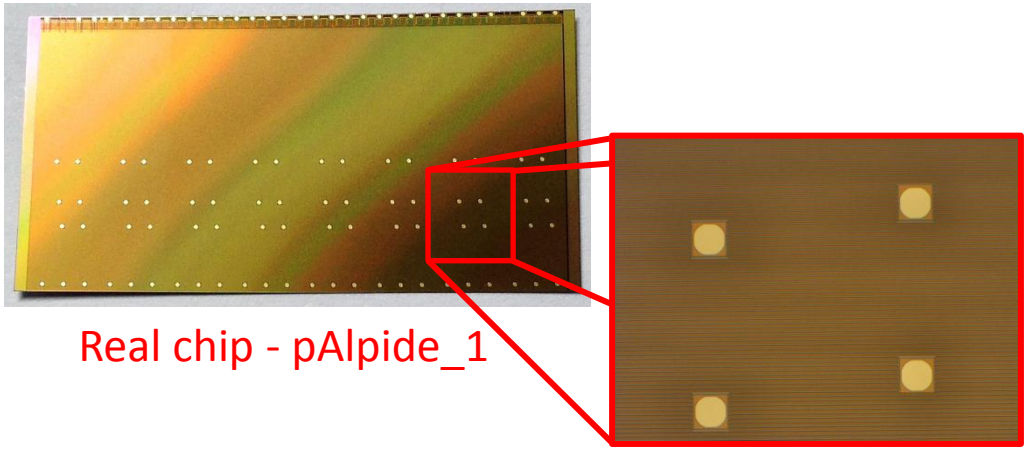




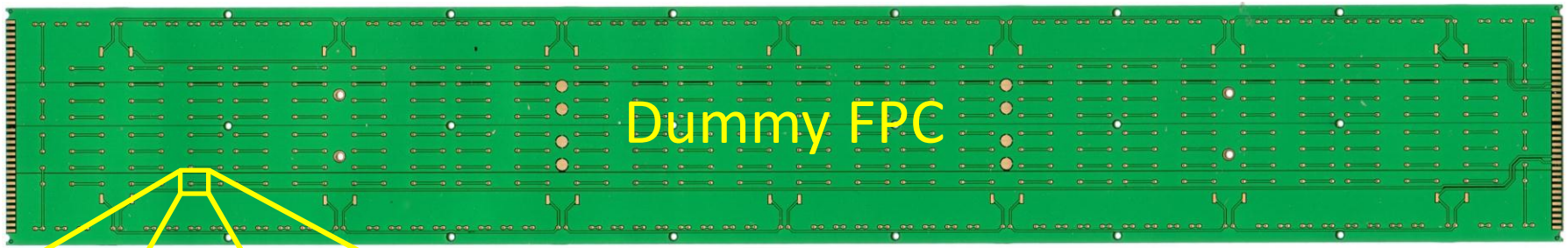
Componenti del modulo

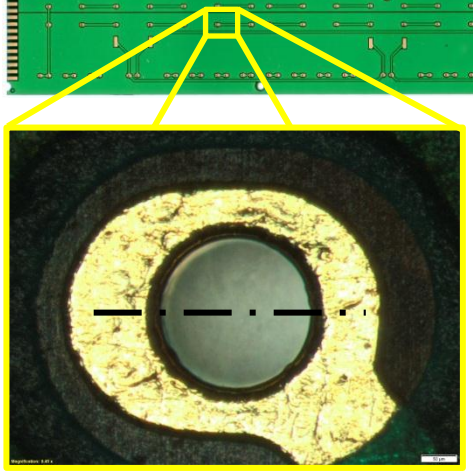


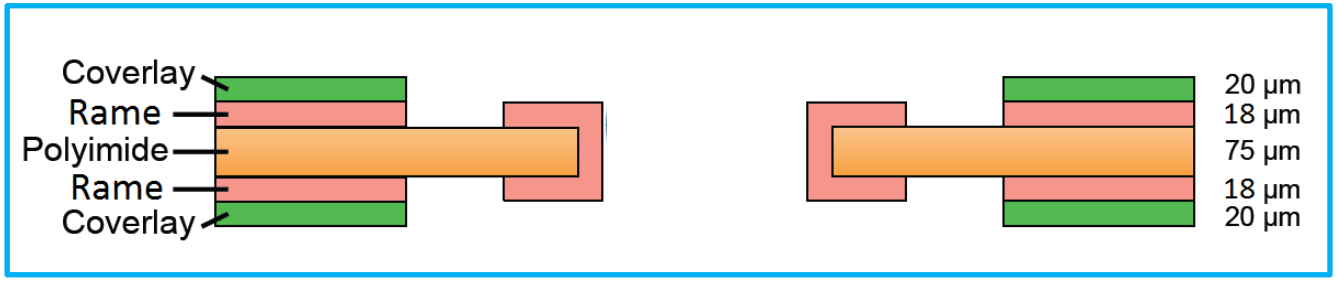
Dummy chip - 50 contacts



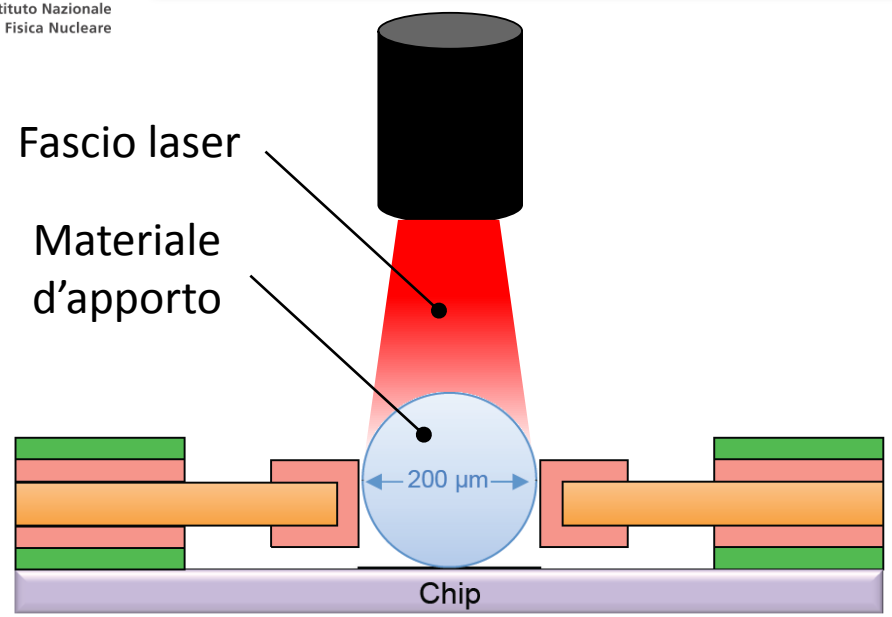
Real chip - pAlpide_1







Processo di saldatura

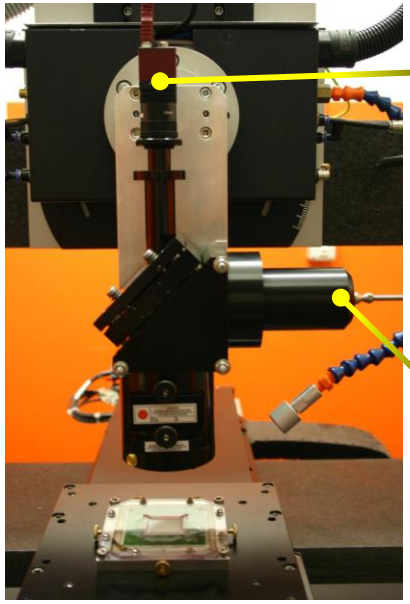


Laser a diodo:
- potenza massima 25 W
- lunghezza d'onda 970 nm

Materiale d'apporto:
- micro-sfere da 200 µm
- lega saldante 96.5Sn 3.5Ag

Peculiarità del processo:
- atmosfera controllata (0.2 mbar)
- assenza di flussante

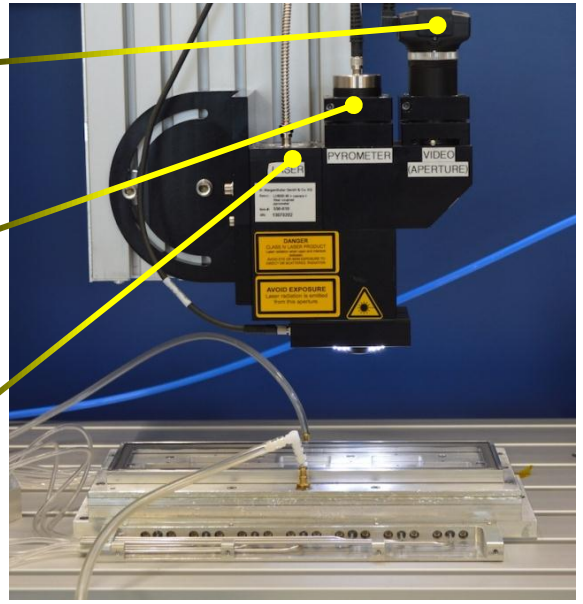
BARI



Camera

Pirometro

Fibra ottica

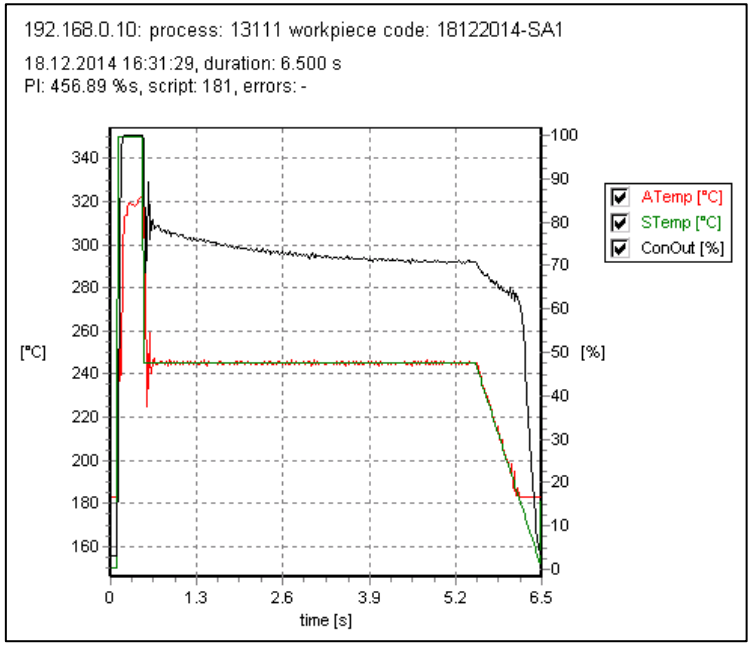


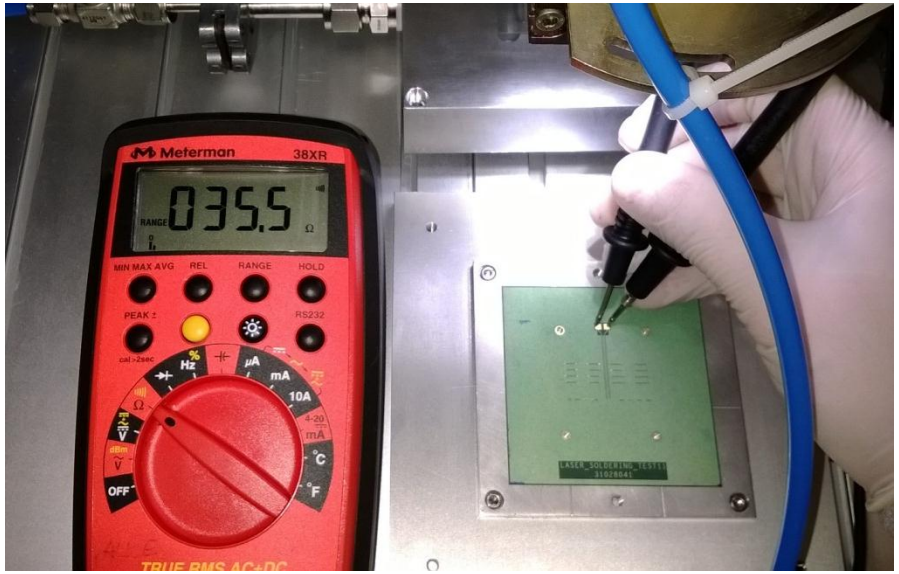
CERN

Controllo del processo di saldatura

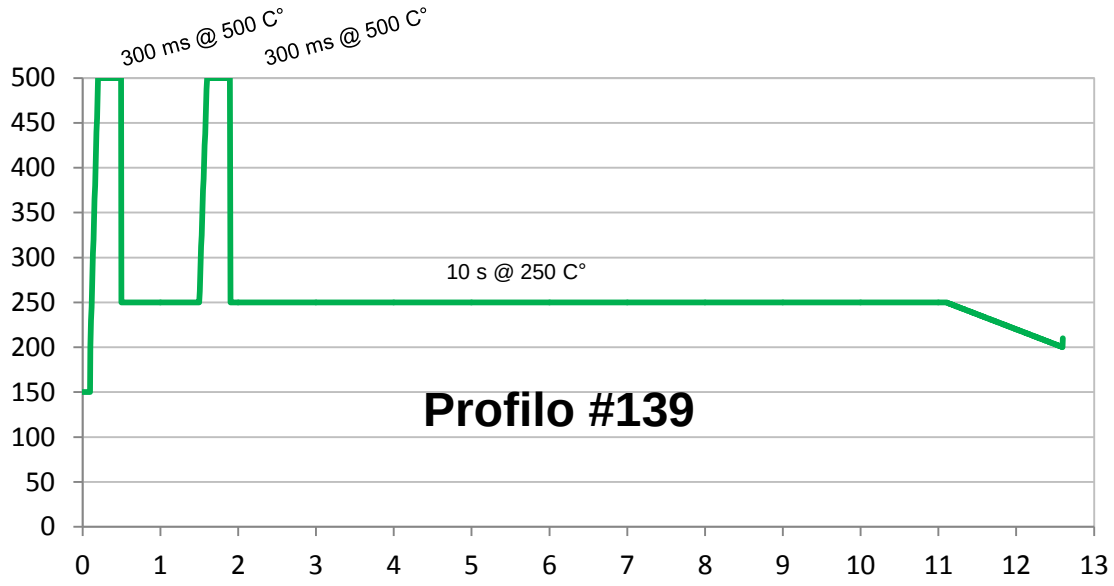
Sono stati implementate 3 modalità di controllo del processo di saldatura:

- Profili di temperatura
- Misura della daisy-chain
- Sezione micrometrica

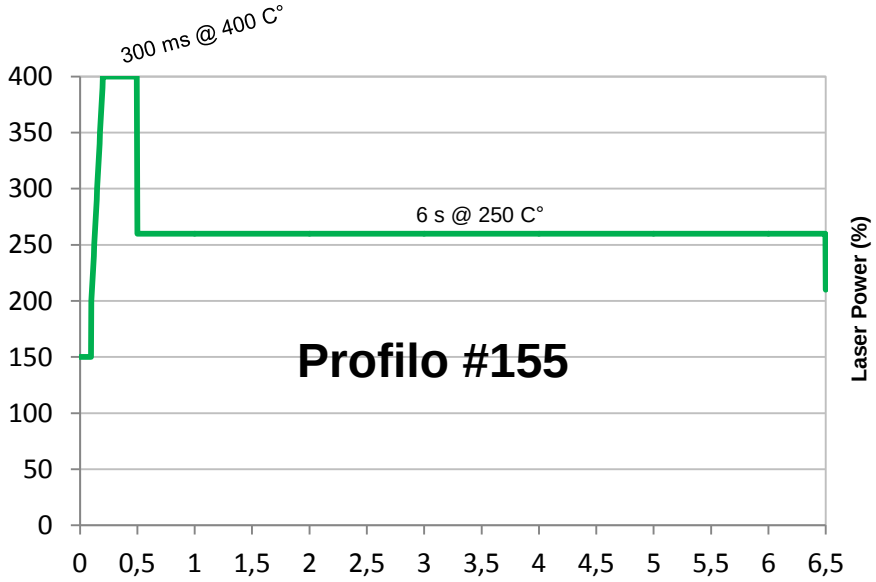


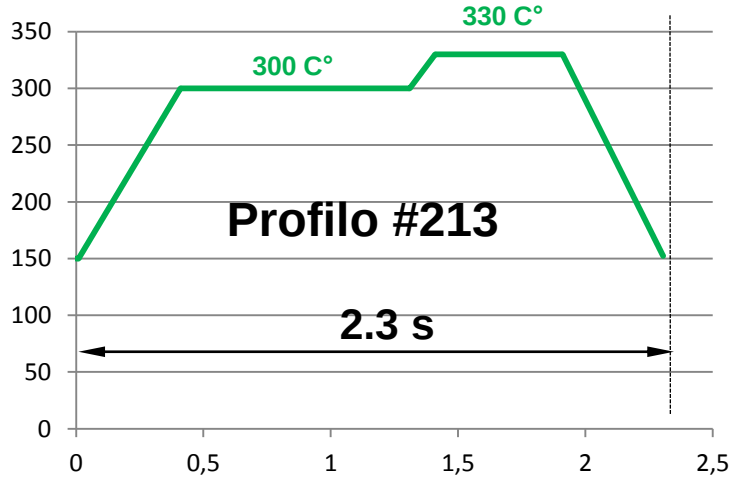


Profili di temperatura

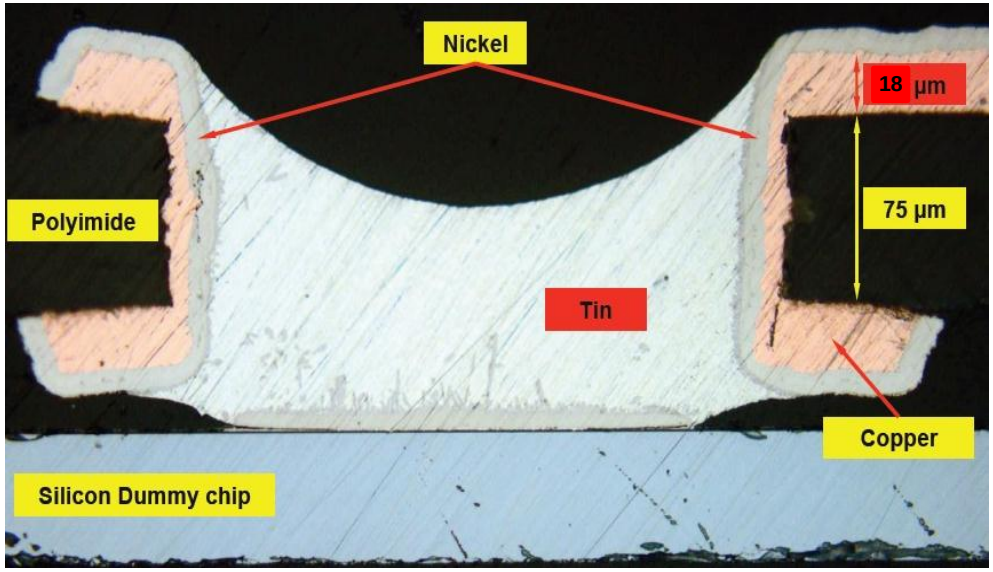


Esempi di profili di temperatura inviati al laser adottati per l'ottimizzazione del processo di saldatura

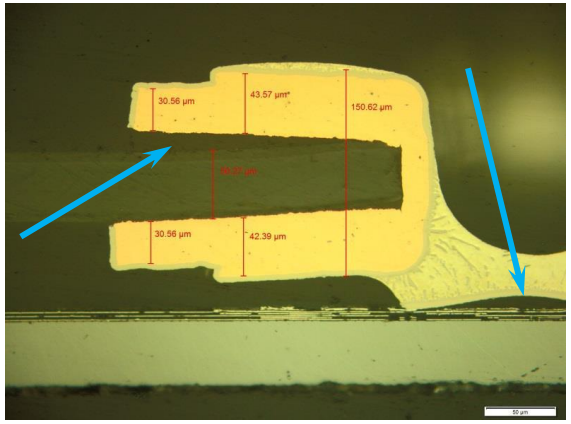




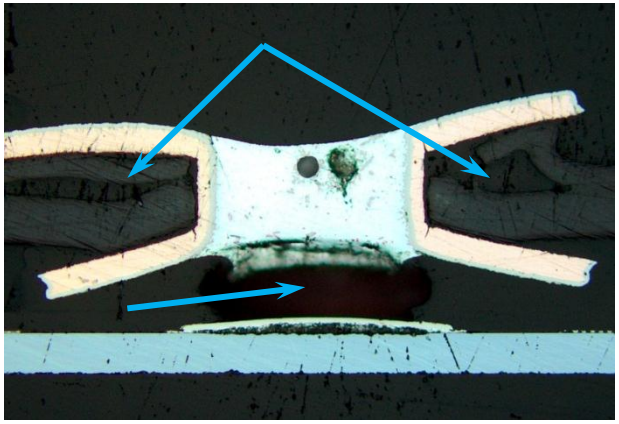
Sezione micrometrica



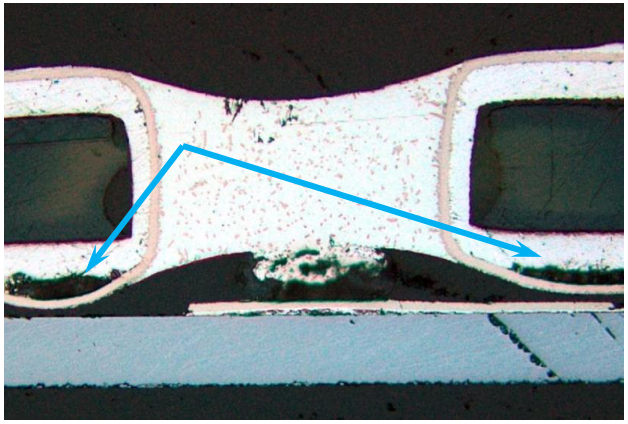
Esempio di sezione micrometrica di una connessione ottimale (ingrandimento 50x).



Quantità del materiale d'apporto insufficiente



Temperature elevate durante il processo di saldatura

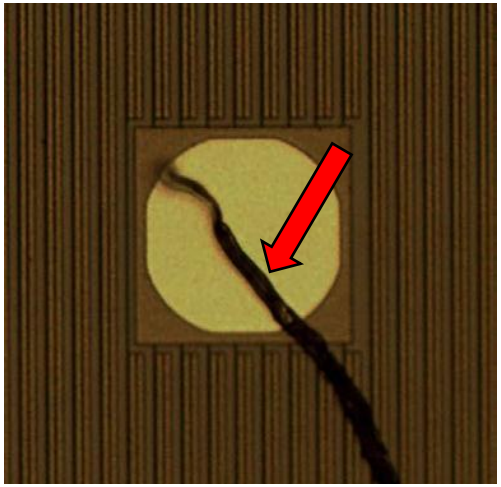


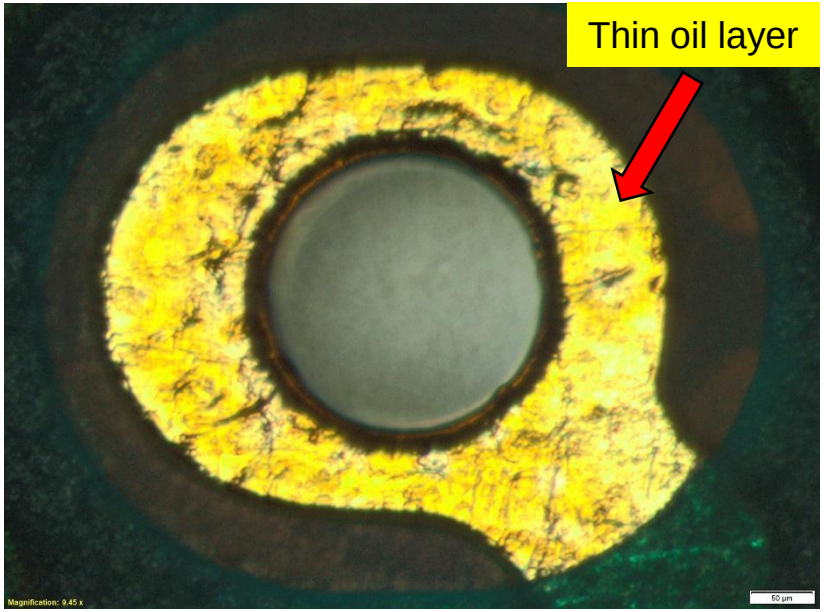
Errori durante il processo di produzione degli FPC

Pulizia dei componenti

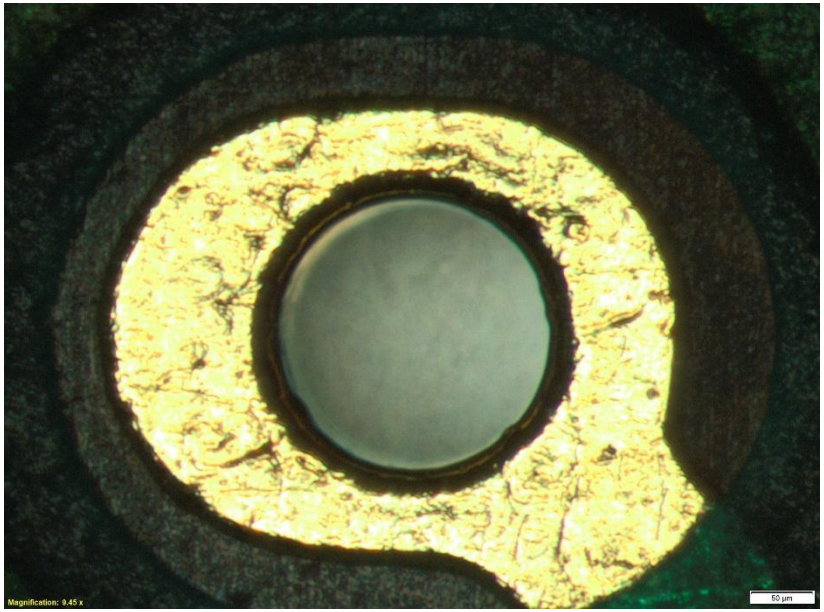
Impurità riscontrate su:

- superfici (e pad) dei chip
- finitura Ni/Au degli FPC





19062015-SA3-PAD-B06
Before cleaning

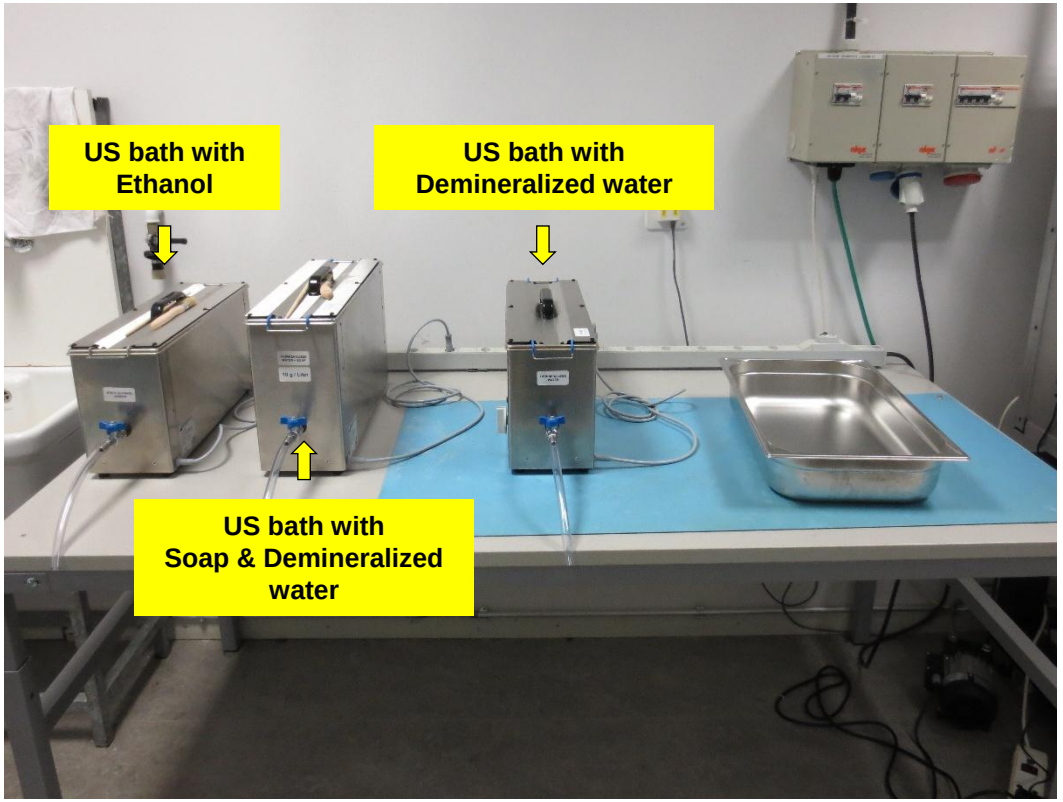


19062015-SA3-PAD-B06
After cleaning

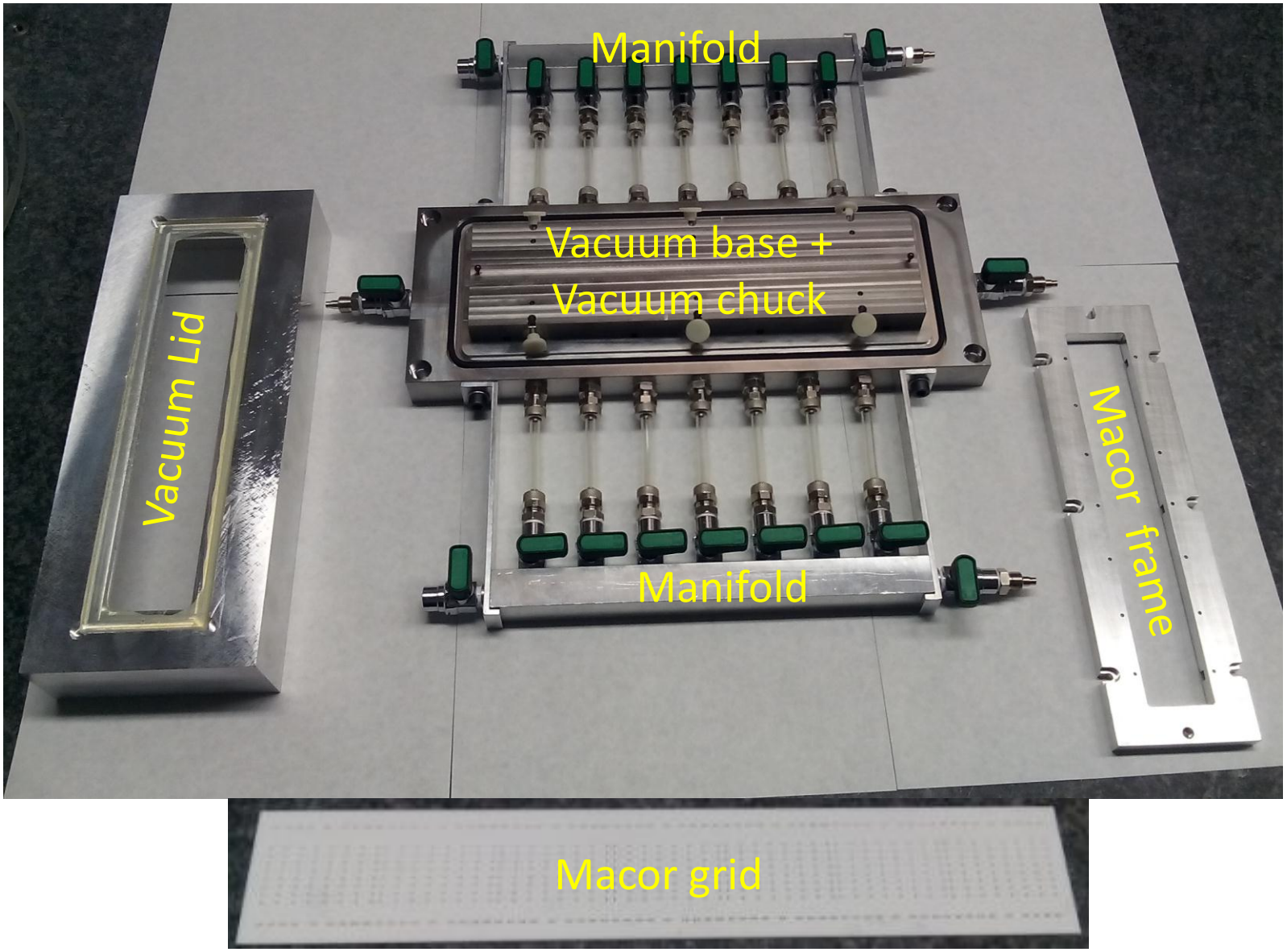
Pulizia dei componenti

Sistema di pulizia con vasche ad ultrasuoni dedicate:

- alcool per i tool
- sapone e acqua demineralizzata per gli FPC

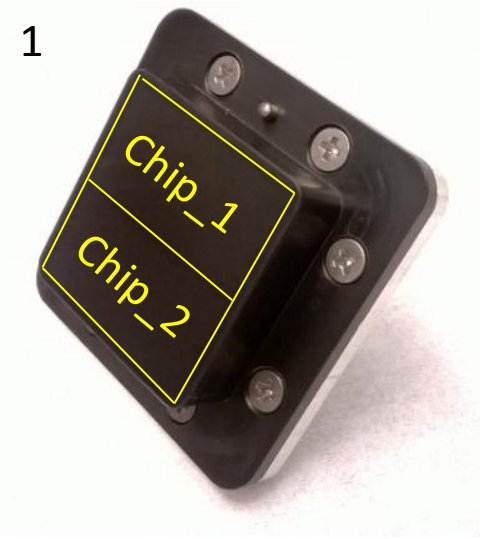


Tool di assemblaggio



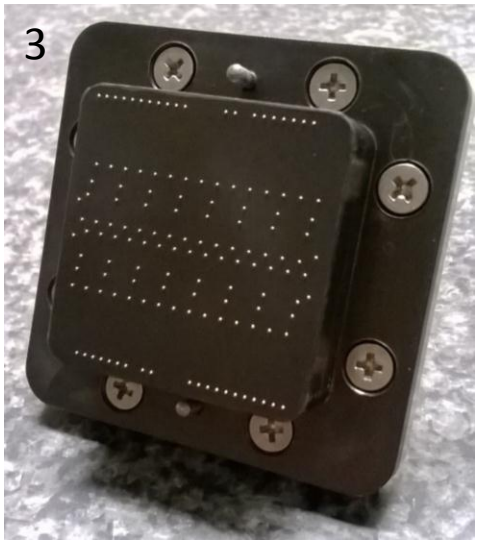
Tool di allineamento delle sferette

1

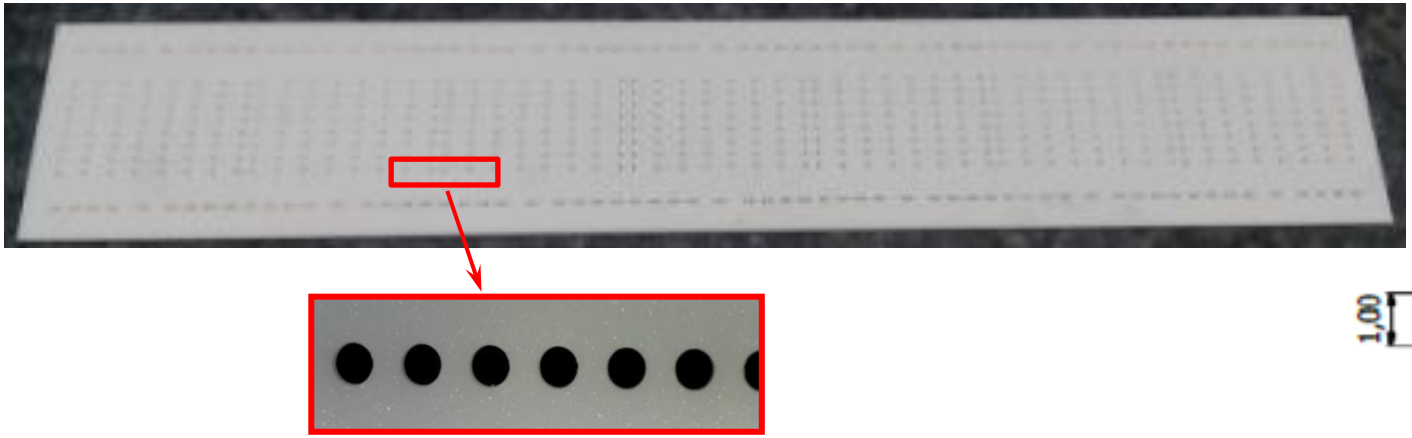


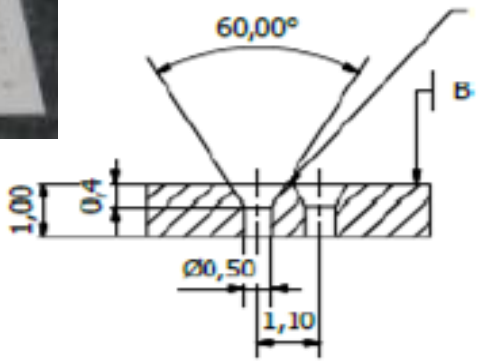
2

3



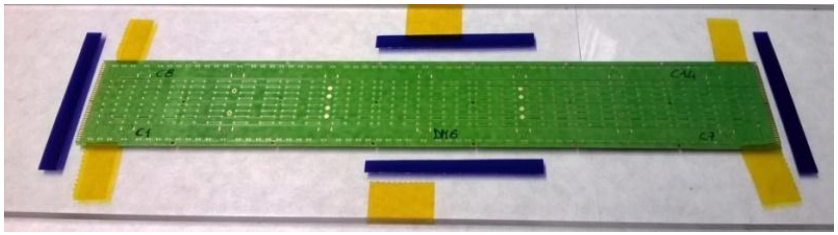
Griglia in Macor dello spessore di 1mm dotata di fori da 0.5 mm

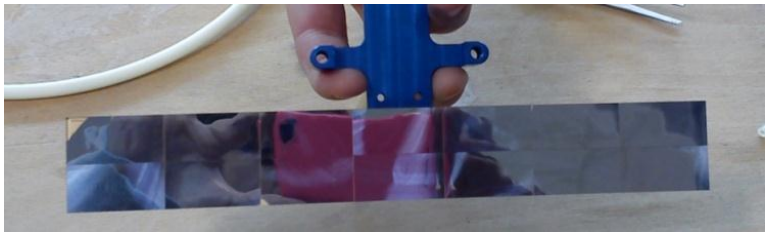




Module Assembly Machine

Prototipo di modulo dummy assemblato presso il CERN





L'intera procedura di allineamento dei chip e di saldatura è stata implementata in una macchina semi-automatica che provverà, in 6 centri produttivi e a partire dal 2016, alla produzione degli oltre 2000 moduli necessari per equipaggare l'intero nuovo tracciatore.

Grazie per l’attenzione!

Date :	10.04.2014						
Sample name :	10042014-SA1						
Flex name :	LASER_SOLDERING_TEST11 (12.02.14)	Polyimide thickness :	50 µm	Solder mask :	Yes		
Holes Ø	215 µm			Degas holes :	No		
Chip :	TMEC 3rd production			Plasma cleaning :	No		
Balls Ø :	200 µm	Alloy :	Sn/Ag Box1	Gas :	No -	Vacuum (90mbar)	

Row 1	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
T° profile	139	139	139	139	139	139	139	139
Process	7727	7728	7729	7730	7731	7732	7733	7734
PI	788%	788%	712%	699%	799%	801%	884%	589%

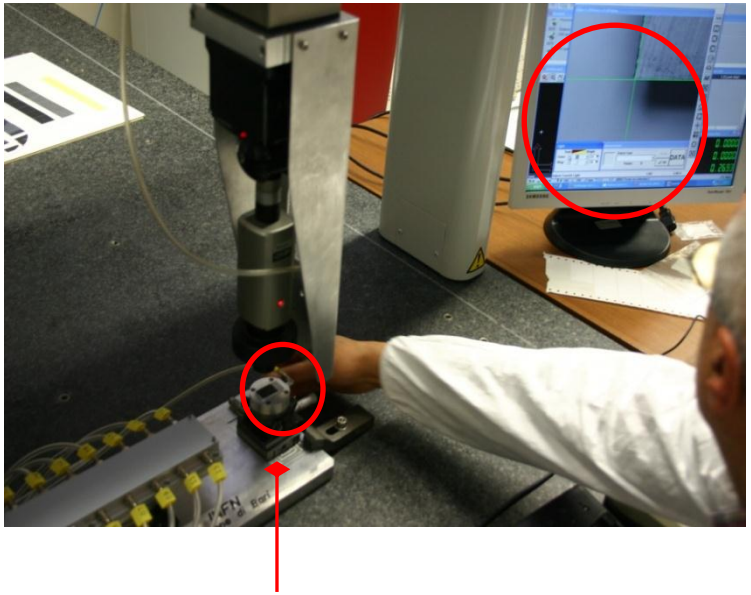
Row 2	PIN 9	PIN 10	PIN 11	PIN 12	PIN 13	PIN 14	PIN 15	PIN 16
T° profile	139	139	139	139	139	139	139	139
Process	7735	7736	7737	7738	7739	7740	7741	7742
PI	918%	785%	770%	626%	806%	731%	753%	842%

Row 3	PIN 17	PIN 18	PIN 19	PIN 20	PIN 21	PIN 22	PIN 23	PIN 24
T° profile	139	139	139	139	139	139	139	139
Process	7743	7744	7745	7746	7747	7748	7749	7750
PI	804%	788%	810%	642%	852%	769%	624%	673%

Row 4	PIN 25	PIN 26	PIN 27	PIN 28	PIN 29	PIN 30	PIN 31	PIN 32
T° profile	139	139	139	139	139	139	139	139
Process	7751	7752	7753	7754	7755	7756	7757	7758
PI	746%	806%	729%	755%	639%	737%	867%	748%

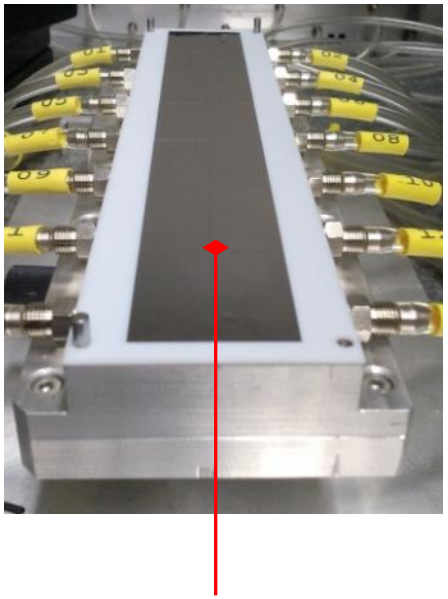
Row5	PIN 33	PIN 34	PIN 35	PIN 36	PIN 37	PIN 38	PIN 39	PIN 40	PIN 41	PIN 42	PIN 43	PIN 44	PIN 45	PIN 46	PIN 47	PIN 48	PIN 49	PIN 50
T° profile	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139
Process	7759	7760	7761	7762	7763	7764	7765	7766	7767	7768	7769	7770	7771	7772	7773	7774	7775	7776
PI	773%	647%	562%	593%	822%	715%	687%	661%	864%	723%	702%	699%	753%	686%	720%	650%	673%	740%

Allineamento dei chip al sistema di coordinate macchina (Mitutoyo) e successivo posizionamento tramite sistema di presa da vuoto a “ginocchio” (errore < 5 um)



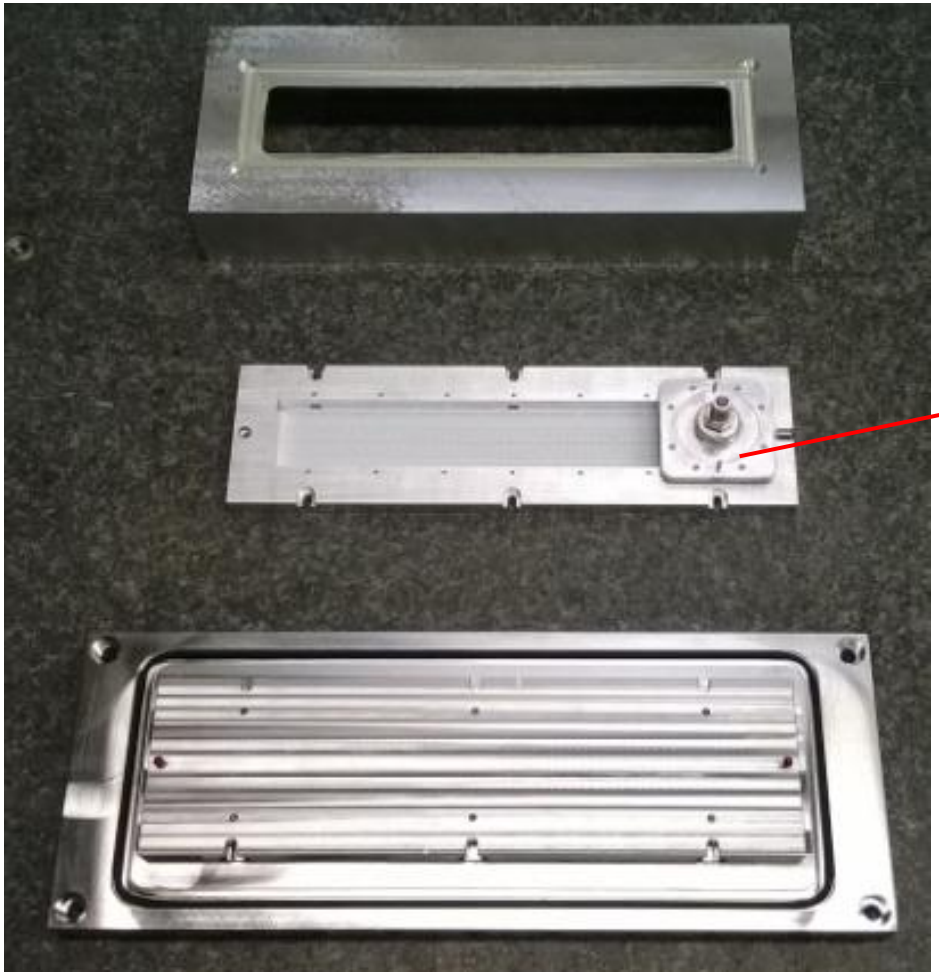
Pre-allineamento chip

presa da vuoto a “ginocchio”



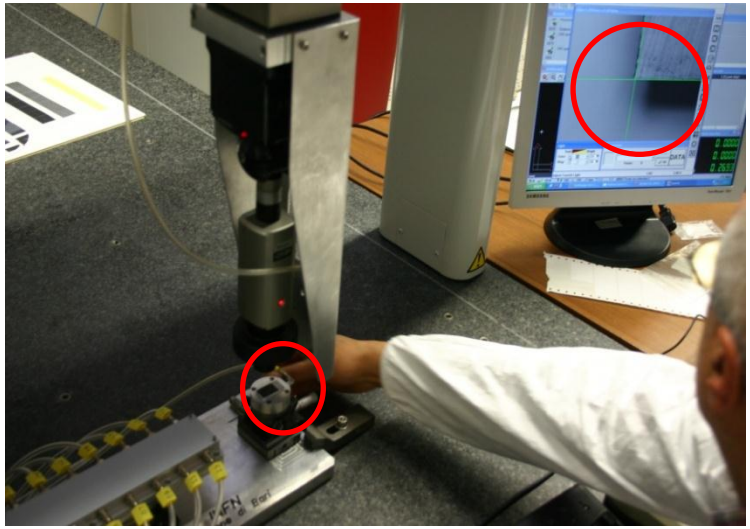
14 chip allineati

OB module assembly table V.1

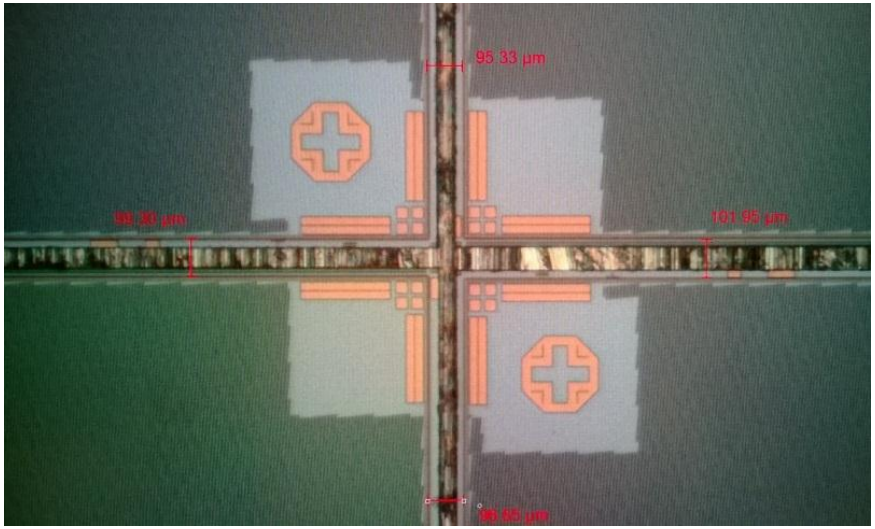


soldering ball transfer tool in conductive material (Tecaform)

Preallineamento dei sensori
con macchina di misura ottica



Controllo della posizione
finale: tolleranza ± 5 μm



Schema delle linee di collegamento tra i dummy chip allineati e l'FPC