



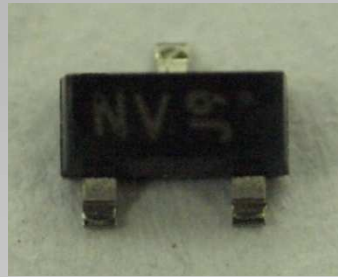
전자부품연구원  
Korea Electronics Technology Institute

# Transistor evaluation result

## 2013.04.26

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Reliability Technology Research Center  
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- Specimen : KRC246S(KEC), DTD123E(ROHM)



<KRC246S>



<DTD123E>

- Test environment :  $(25 \pm 10) ^\circ\text{C}$ , Below 75 % R.H.
- Test equipment
  - Curve tracer, Tektronix(U.S.A.), 370A
  - Discrete device test system, Statec(Korea), STA2100
  - Network analyzer, Agilent(U.S.A.), 8722ES
  - Decapsulator, MIS(Korea), MIS/MA2005A
  - Bond pull tester, Nordson(U.S.A.), Dage 4000
- Test timing: 2013.2.28 ~4.19



• Result: Electrical characteristics

DTD123EK(ROHM)

Parameter	Symbol	Test condition	Unit	Specification			Result									
				Min.	Typ.	Max.	1	2	3	4	5	6	7	8	9	10
Input voltage	$V_{I(on)}$	$V_O = 0.3\text{ V}, I_O = 20\text{ mA}$	V	-	-	3.0	1.625 ( $I_O = 20.00\text{ mA}, V_O = 302.5\text{ mV}$ )	1.625 ( $I_O = 20.25\text{ mA}, V_O = 311.5\text{ mV}$ )	1.630 ( $I_O = 20.20\text{ mA}, V_O = 312.5\text{ mV}$ )	1.610 ( $I_O = 20.20\text{ mA}, V_O = 313.0\text{ mV}$ )	1.625 ( $I_O = 20.25\text{ mA}, V_O = 312.0\text{ mV}$ )	1.610 ( $I_O = 20.25\text{ mA}, V_O = 313.0\text{ mV}$ )	1.610 ( $I_O = 20.05\text{ mA}, V_O = 303.0\text{ mV}$ )	1.605 ( $I_O = 20.30\text{ mA}, V_O = 313.0\text{ mV}$ )	1.605 ( $I_O = 20.20\text{ mA}, V_O = 316.0\text{ mV}$ )	1.605 ( $I_O = 20.15\text{ mA}, V_O = 301.5\text{ mV}$ )
Input voltage	$V_{I(off)}$	$V_O = 5.0\text{ V}, I_O = 100\text{ }\mu\text{A}$	V	0.5	-	-	1.130 ( $I_O = 103.6\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.126 ( $I_O = 101.4\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.128 ( $I_O = 101.6\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.124 ( $I_O = 100.6\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.124 ( $I_O = 101.0\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.122 ( $I_O = 101.2\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.122 ( $I_O = 103.4\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.120 ( $I_O = 103.0\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.118 ( $I_O = 101.0\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	1.120 ( $I_O = 102.8\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )
Output voltage	$V_{O(on)}$	$I_O / I_I = 50.0\text{ mA} / 2.5\text{ mA}$	V	-	0.1	0.3	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.042	0.043	0.043
Input current	$I_I$	$V_I = 5.0\text{ V}$	mA	-	-	3.8	1.941	1.942	1.940	1.936	1.954	1.918	1.923	1.902	1.909	1.910
Output current	$I_{O(off)}$	$V_O = 50.0\text{ V}, V_I = 0\text{ V}$	$\mu\text{A}$	-	-	0.5	0.021	0.031	0.007	0.011	0.034	0.016	0.021	0.014	0.005	0.010
DC current gain	$G_I$	$V_O = 5.0\text{ V}, I_O = 50\text{ mA}$	-	39	-	-	85.98	86.74	86.38	87.25	85.33	89.80	89.47	91.70	91.58	91.24

Judgment: All test data is within spec

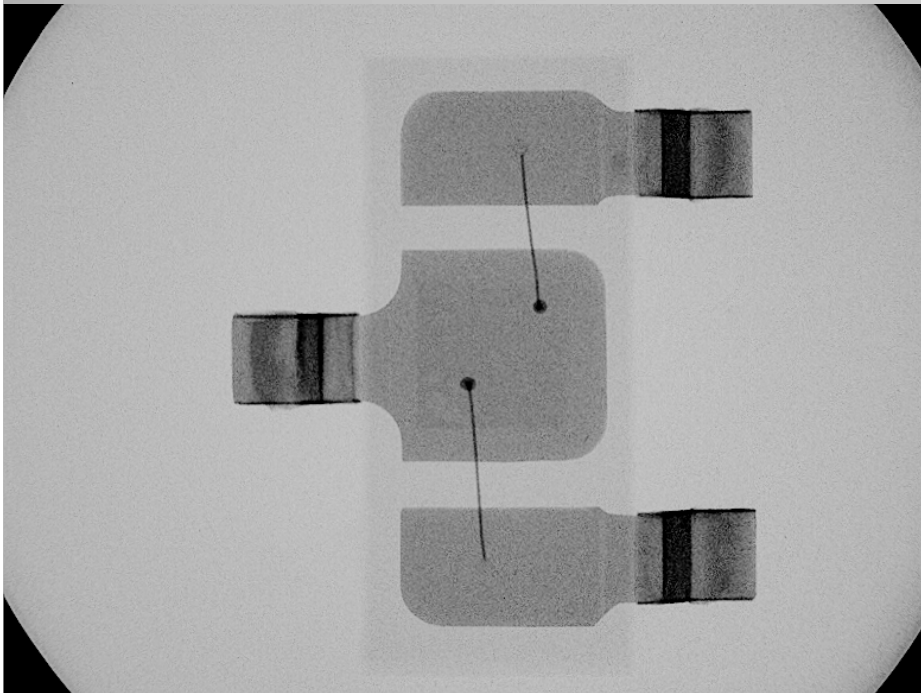
KRC246(KEC)

Parameter	Symbol	Test condition	Unit	Specification			Result									
				Min.	Typ.	Max.	1	2	3	4	5	6	7	8	9	10
Input voltage	$V_{I(on)}$	$V_O = 0.3\text{ V}, I_O = 20\text{ mA}$	V	-	-	2.0	1.045 ( $I_O = 20.35\text{ mA}, V_O = 303.5\text{ mV}$ )	1.040 ( $I_O = 20.05\text{ mA}, V_O = 311.5\text{ mV}$ )	1.040 ( $I_O = 20.00\text{ mA}, V_O = 314.0\text{ mV}$ )	1.025 ( $I_O = 20.05\text{ mA}, V_O = 312.0\text{ mV}$ )	1.045 ( $I_O = 20.20\text{ mA}, V_O = 308.0\text{ mV}$ )	1.040 ( $I_O = 20.05\text{ mA}, V_O = 313.5\text{ mV}$ )	1.040 ( $I_O = 20.05\text{ mA}, V_O = 315.5\text{ mV}$ )	1.045 ( $I_O = 20.05\text{ mA}, V_O = 315.0\text{ mV}$ )	1.030 ( $I_O = 20.15\text{ mA}, V_O = 312.5\text{ mV}$ )	1.045 ( $I_O = 20.35\text{ mA}, V_O = 307.0\text{ mV}$ )
Input voltage	$V_{I(off)}$	$V_O = 5.0\text{ V}, I_O = 100\text{ }\mu\text{A}$	V	0.3	-	-	0.664 ( $I_O = 104.2\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.664 ( $I_O = 104.6\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.661 ( $I_O = 100.8\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.660 ( $I_O = 102.2\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.660 ( $I_O = 102.2\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.659 ( $I_O = 101.8\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.659 ( $I_O = 100.6\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.661 ( $I_O = 100.4\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.661 ( $I_O = 103.0\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )	0.660 ( $I_O = 101.8\text{ }\mu\text{A}, V_O = 5.0\text{ V}$ )
Output voltage	$V_{O(on)}$	$I_O / I_I = 50.0\text{ mA} / 2.5\text{ mA}$	V	-	0.1	0.3	0.042	0.041	0.041	0.040	0.041	0.042	0.040	0.041	0.042	0.042
Input current	$I_I$	$V_I = 5.0\text{ V}$	mA	-	-	3.6	2.040	2.083	2.076	2.099	2.032	2.070	2.061	2.065	2.115	2.101
Output current	$I_{O(off)}$	$V_O = 30.0\text{ V}, V_I = 0\text{ V}$	$\mu\text{A}$	-	-	10	0.000	0.015	0.007	0.020	0.008	0.043	0.010	0.004	0.009	0.017
DC current gain	$G_I$	$V_O = 5.0\text{ V}, I_O = 50\text{ mA}$	-	56	-	-	159.34	156.86	157.26	164.46	159.51	157.97	158.65	156.91	160.71	155.18

Judgment: All test data is within spec

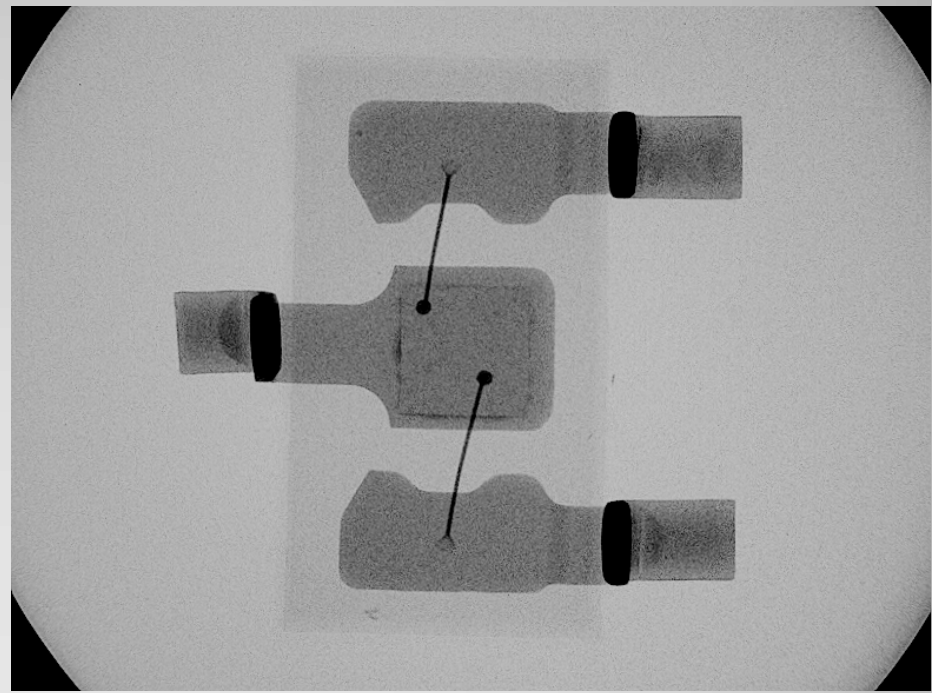
- Wire bond analysis(X-Ray)

KRC246



Judgment: There is no foreign substance.

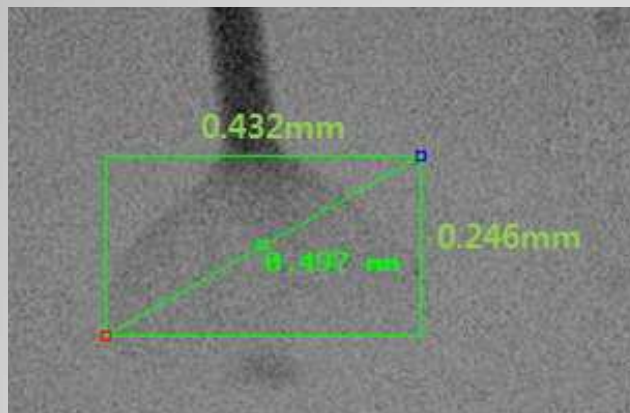
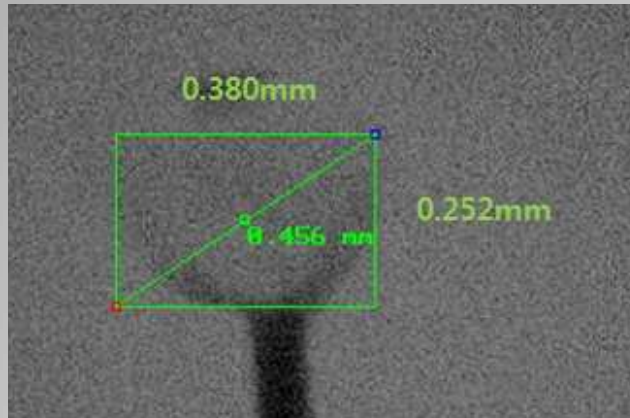
DTD123EK



Judgment: There is no foreign substance.

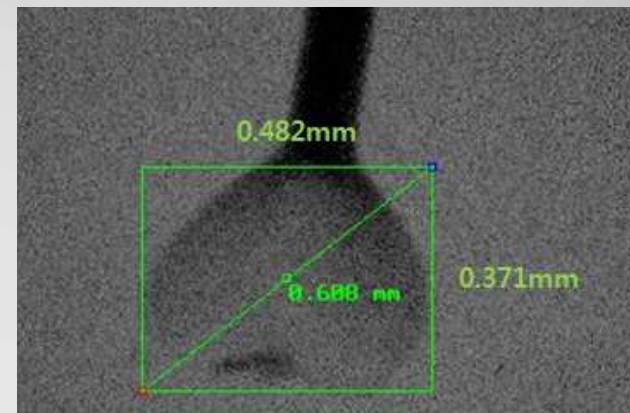
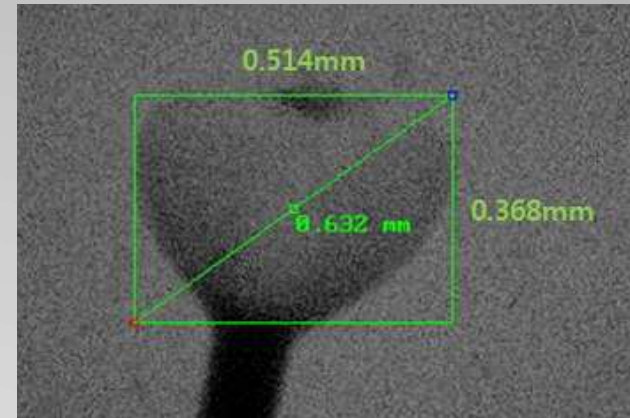
- Wire bond analysis(X-Ray)

KRC246: 2<sup>nd</sup> bonding



Judgment: Stitch shape is standard style.

DTD123EK: 2<sup>nd</sup> bonding



Judgment: Stitch shape is standard style.



- Wire bond analysis(SEM)



(Left) KRC246 / (Right) DTD123EK

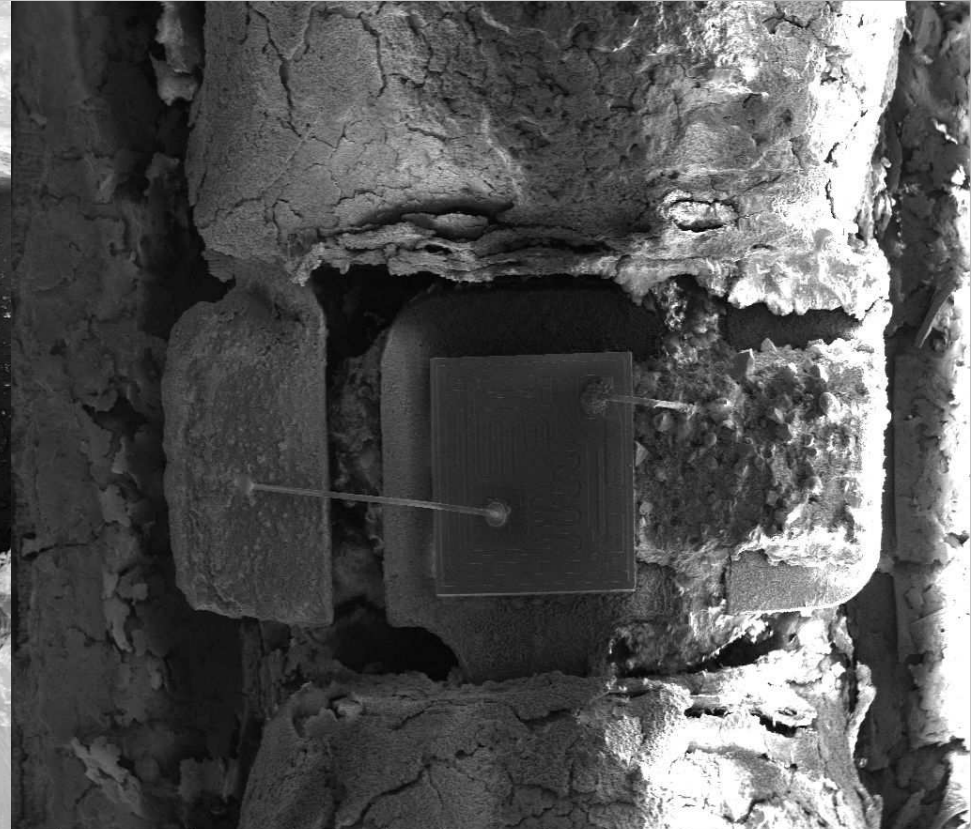
- Wire bond analysis(SEM)

KRC246

DTD123EK



4/17/2013 HV mag tilt WD det  
8:01:57 PM 10.0 kV 51 x -0° 17.9 mm ETD

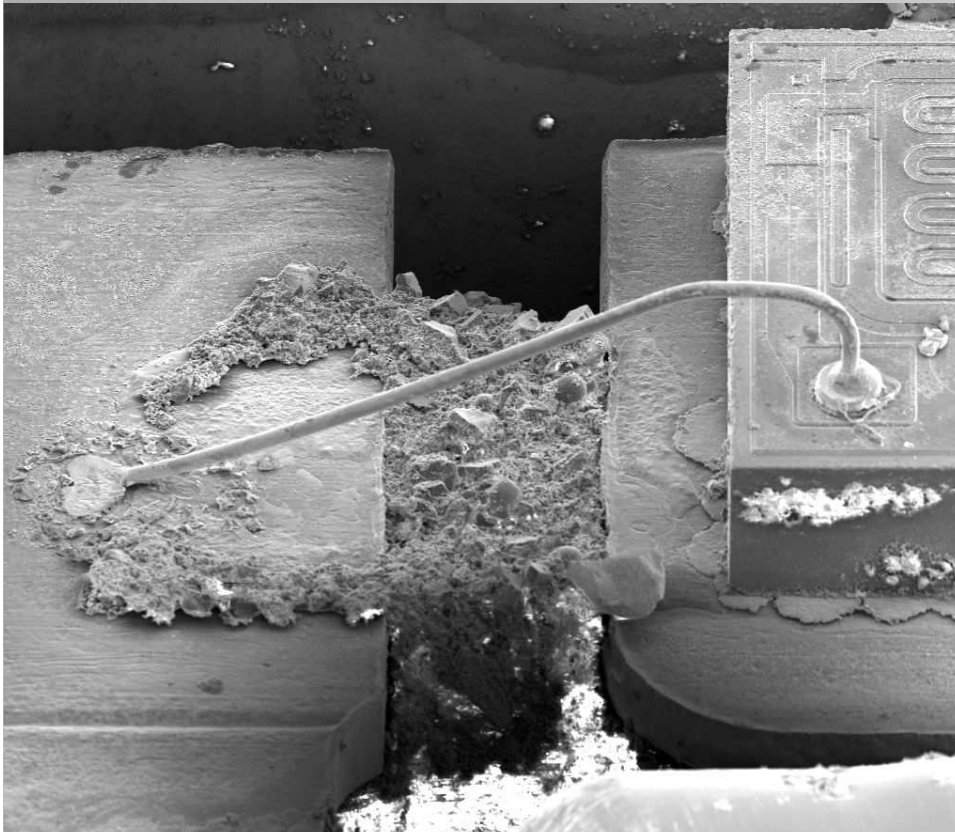


4/9/2013 HV mag tilt WD det  
5:59:16 PM 10.0 kV 54 x -0° 16.8 mm ETD

- Wire bond analysis(SEM): Wire bonding

KRC246

DTD123EK



4/17/2013	HV	mag	tilt	WD	det	300 μm
8:08:21 PM	10.0 kV	150 x	50 °	20.5 mm	ETD	

Judgment: There is no problem.



4/9/2013	HV	mag	tilt	WD	det	300 μm
5:16:03 PM	10.0 kV	150 x	50 °	18.1 mm	ETD	

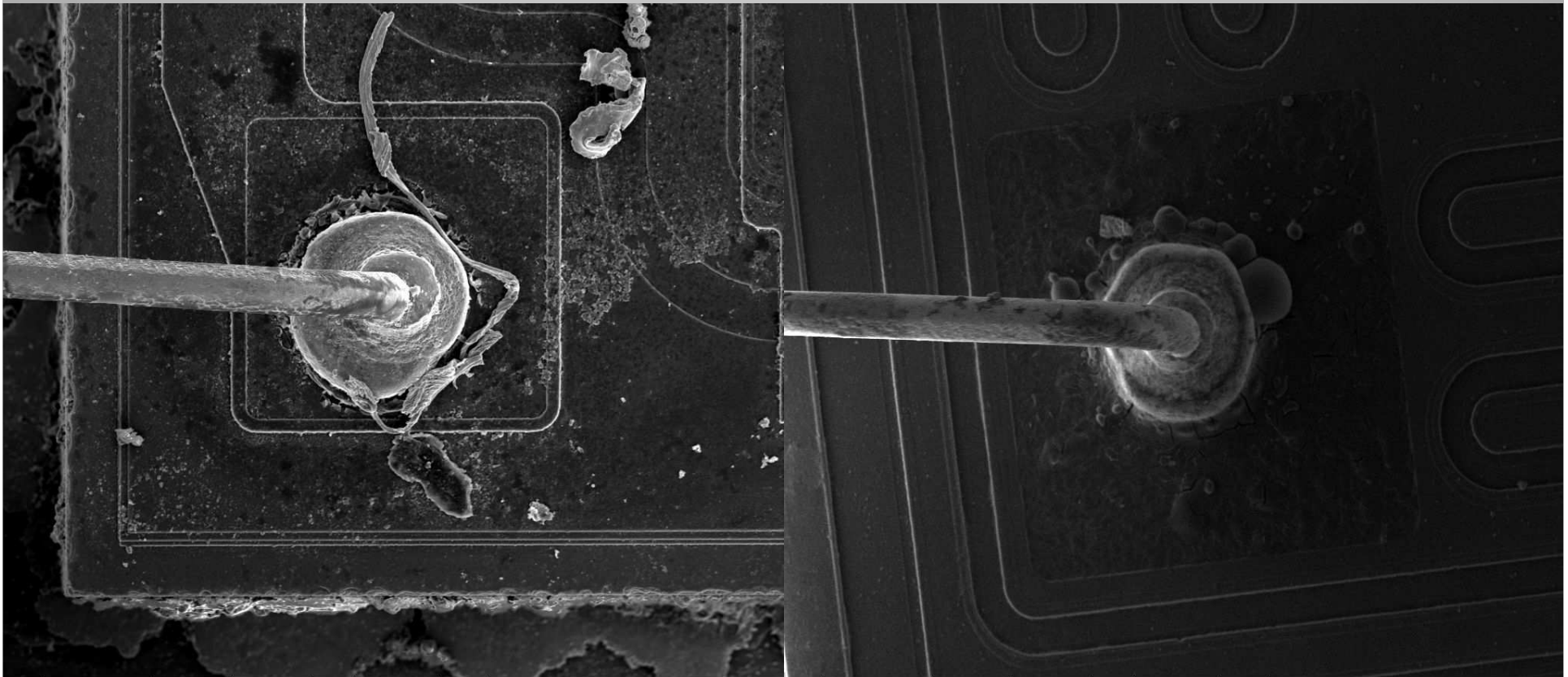
Judgment: There is no problem.



- Wire bond analysis(SEM): 1<sup>st</sup> bonding

KRC246

DTD123EK



4/17/2013 HV mag tilt WD det  
8:11:07 PM 10.0 kV 500 x -0° 16.3 mm ETD

100 μm

4/9/2013 HV mag tilt WD det  
4:45:49 PM 10.0 kV 500 x -0° 14.6 mm ETD

100 μm

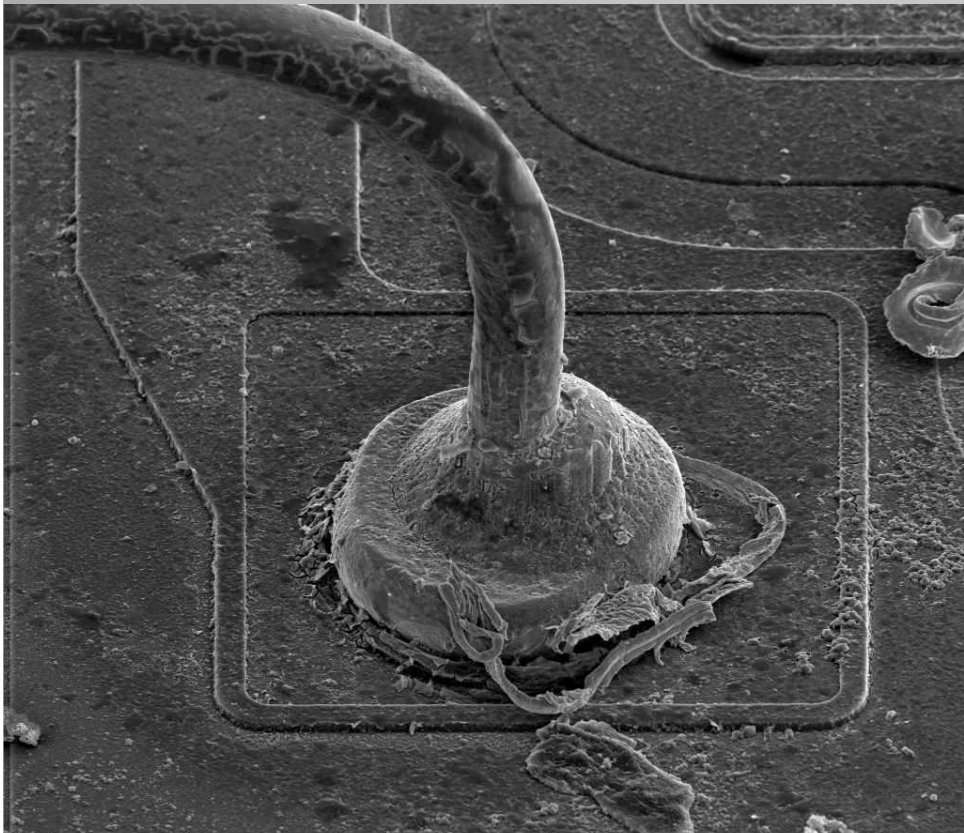
Judgment: Bonding wire is damaged,  
due to solvent material.

Judgment: There is no problem.

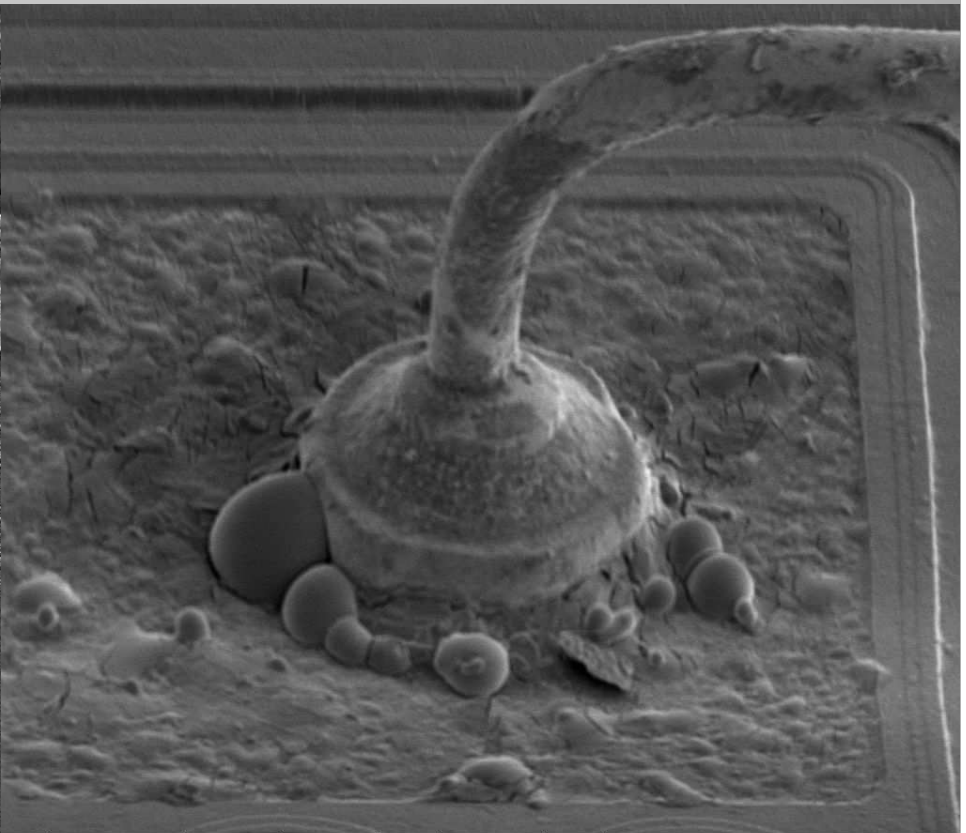
- Wire bond analysis(SEM): 1<sup>st</sup> bonding

KRC246

DTD123EK



4/17/2013 8:24:48 PM HV 10.0 kV mag 800 x tilt 50 ° WD 20.0 mm det ETD 50 μm



4/9/2013 5:53:15 PM HV 5.00 kV mag 800 x tilt 50 ° WD 20.1 mm det ETD 50 μm

Judgment: There is no problem.

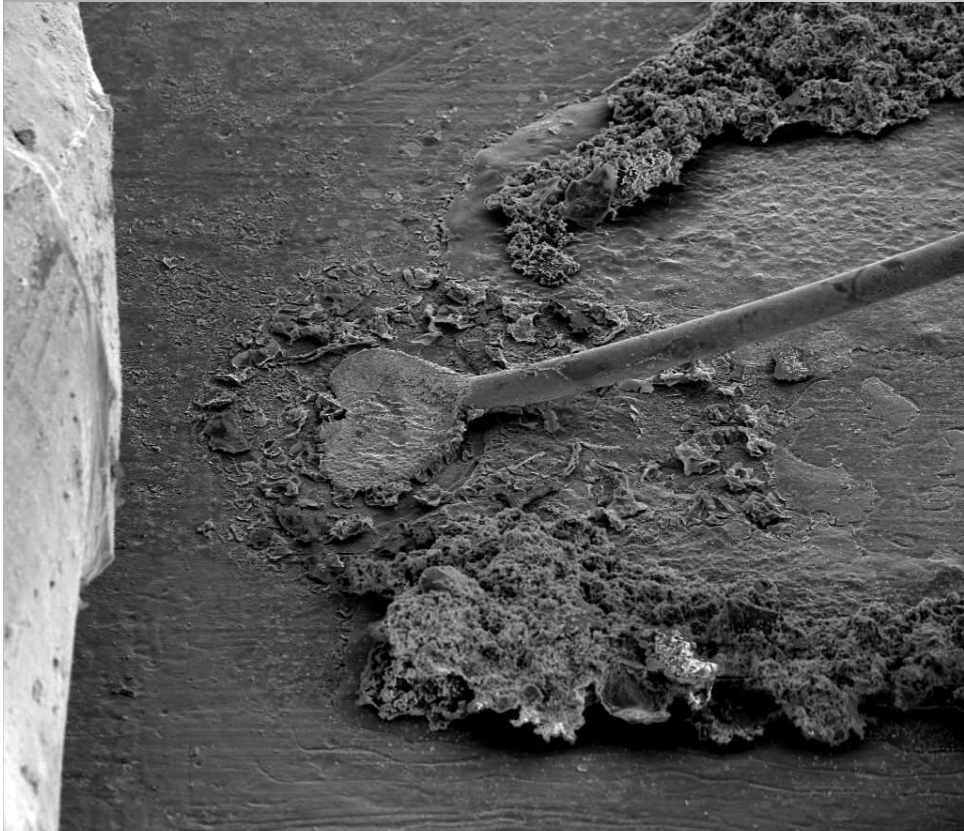
Judgment: There is no problem.



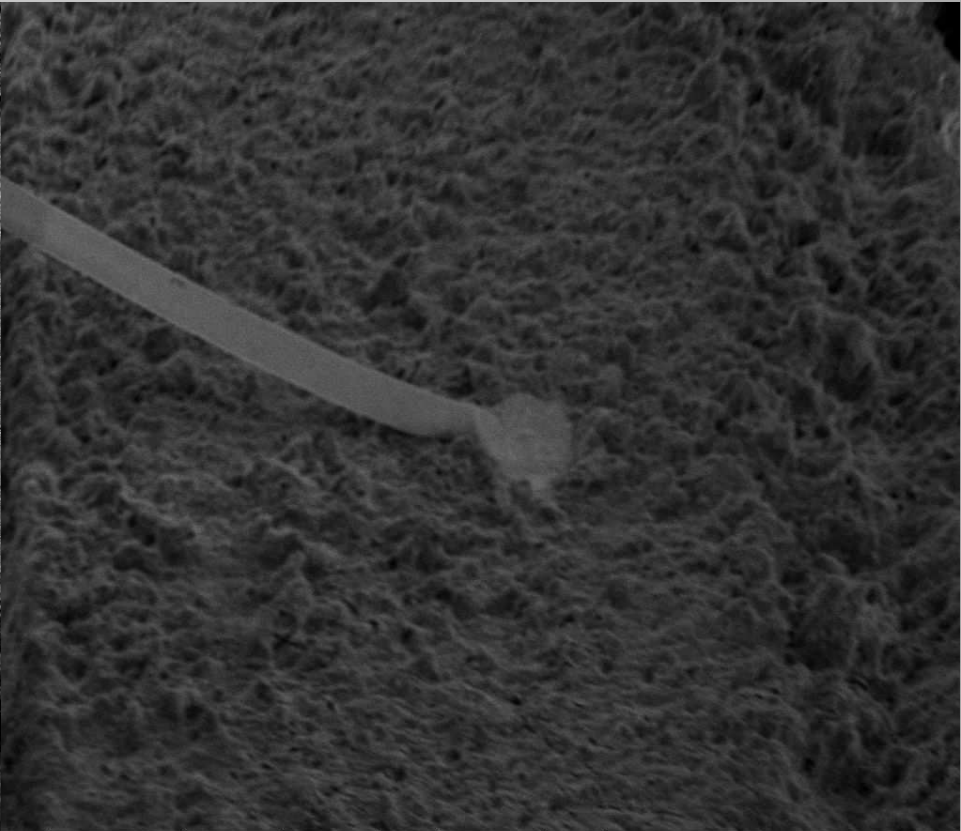
- Wire bond analysis(SEM): 2<sup>nd</sup> bonding

KRC246

DTD123EK



4/17/2013 8:32:01 PM HV 10.0 kV mag 350 x tilt 50 ° WD 20.3 mm det ETD 100 μm



4/9/2013 5:43:41 PM HV 15.0 kV mag 350 x tilt 50 ° WD 20.9 mm det ETD 100 μm

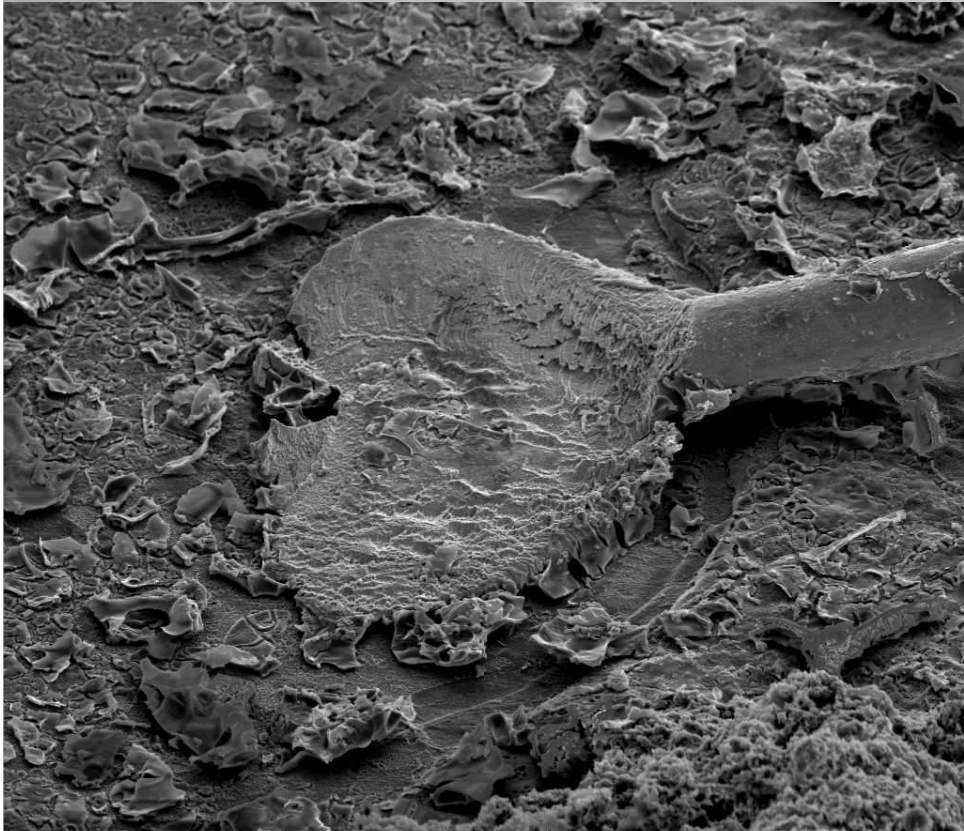
Judgment: There is no crushing by stitch.

Judgment: Stitch shape is a little bit thin.

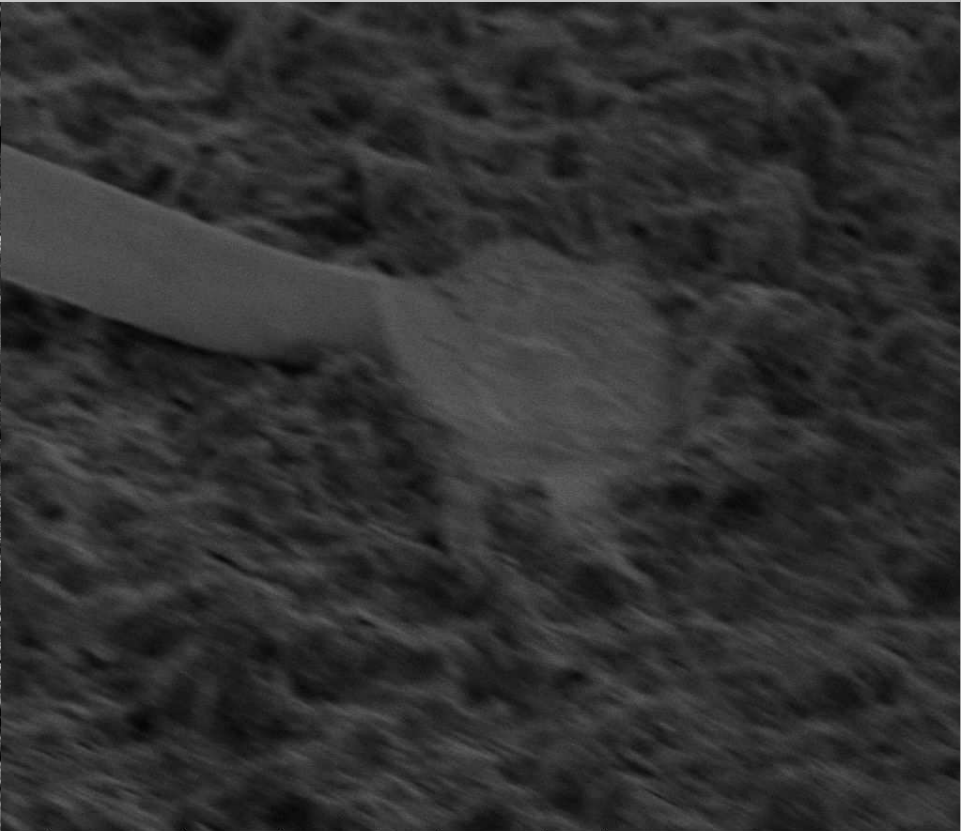
- Wire bond analysis(SEM): 2<sup>nd</sup> bonding

KRC246

DTD123EK



4/17/2013 HV mag tilt WD det  
8:28:23 PM 10.0 kV 1 000 x 50 ° 20.3 mm ETD 50 μm



4/9/2013 HV mag tilt WD det  
5:47:12 PM 15.0 kV 1 000 x 50 ° 21.0 mm ETD 50 μm

Judgment: There is no crushing by stitch.

Judgment: Stitch shape is a little bit thin.