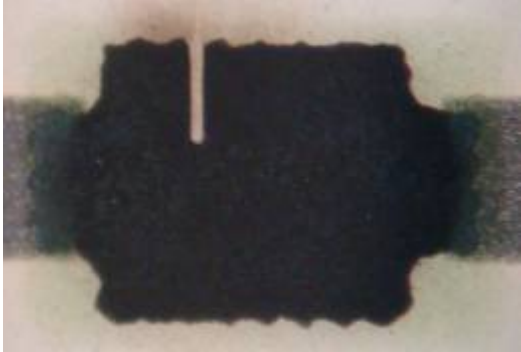
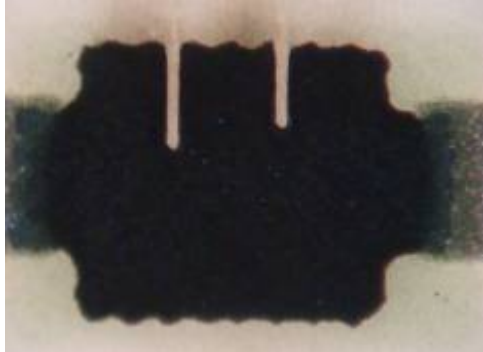
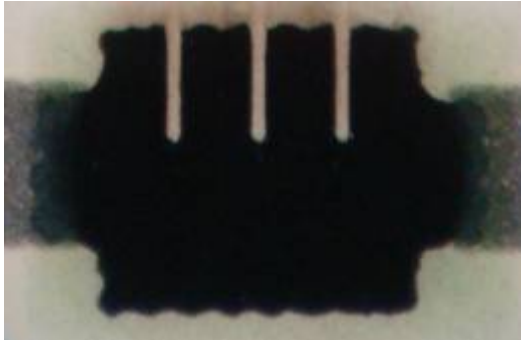
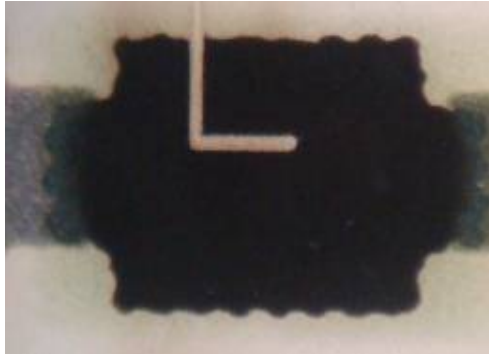


Analysis of laser trimming line

§0 . Abstract

Laser trimming is an indispensable process during chip resistor production, which trims resistance values to fall in tolerance range required by customers. Trimming methods used for different products and different resistance values are varied, such as "I-Shape", "II-Shape" , "III-Shape" and "L-Shape" trimming, etc.

§1 . Trimming line images

	
"I-Shape" trimmed ok product	"II-Shape" trimmed ok product
	
"III-Shape" trimmed ok product	"L-Shape" trimmed ok product

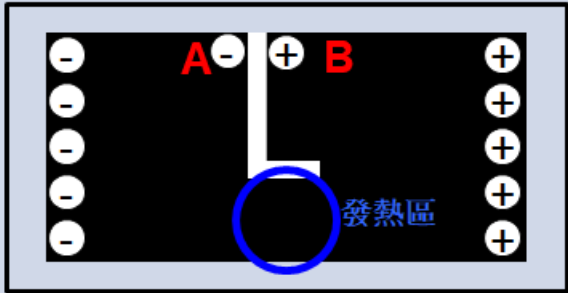
Analysis of laser trimming line

§2 . Inspection tool in laser trimming process

Confirm trimming line appearance and position with a 40X microscope



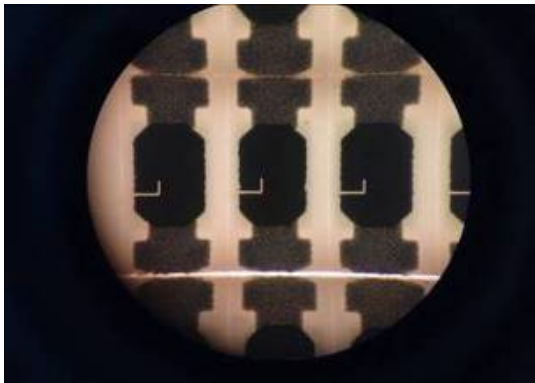
§3 . Laser trimming line principle explanation

Item	L-Shape trimming
Image	
Principle explanation	◆ This laser trimming method applies rated voltage in a high temperature and humidity environment. After prolonged operation, the conductive layer of the resistor becomes damp, and the resistance value is detected at high voltage under constant environmental conditions, resulting in a decrease in resistance value; ◆ When applying rated voltage on both sides of the L-Shape trimming line and working for a long time under damp conditions, the phenomenon of "arc short circuiting" will appear when there are trimming line residues, resulting in a decrease in resistance value.

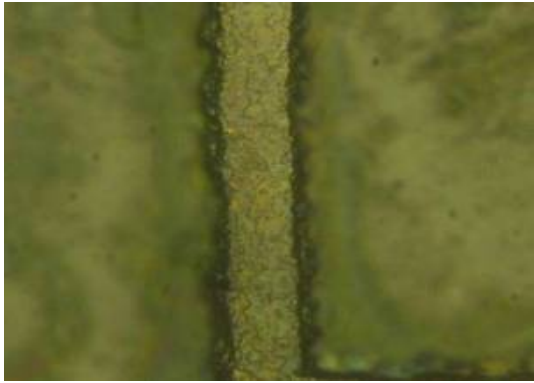
Analysis of laser trimming line

§4 . Analysis of laser trimming line appearance

Take one sheet of resistors from laser trimming workshop at random, confirm appearance of the trimming lines, grind those with ok appearance and analyze trimming line composition by SEM. The weight ratio of the lead component is 3.69%. Details are as follows:

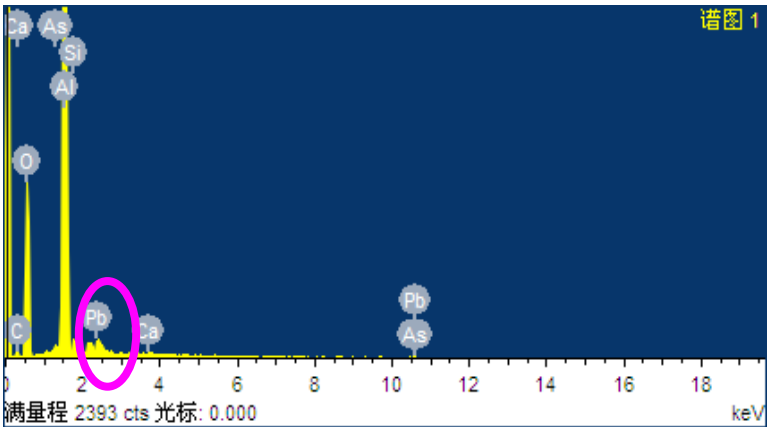


Trimming line appearance 40 X



Trimming line appearance 1000X

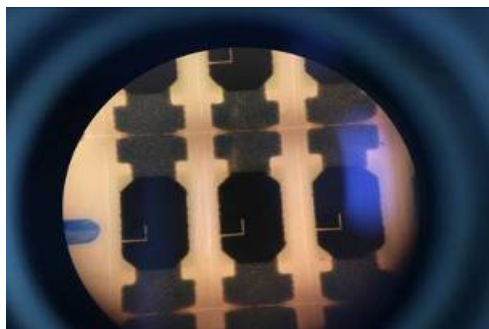
元素	量重	原子
	百分比	百分比
C K	4.79	8.2
O K	41.99	53.95
Al K	47.55	36.23
Si K	1.43	1.04
Ca K	0.29	0.15
As L	0.26	0.07
Pb M	3.69	0.37
总量	100	



Composition testing

Analysis of laser trimming line

2. Intentionally produce semi-finished products with unclean trimming lines and send them to SEM for composition testing and find the weight ratio of lead is 6.33%. Details are as below:



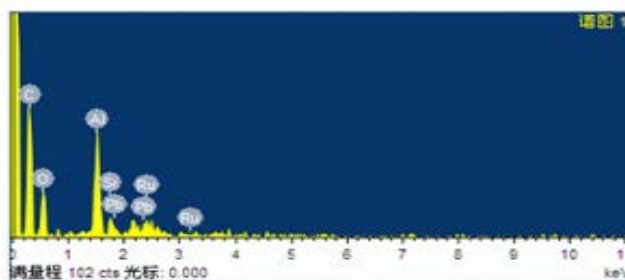
Trimming line appearance 40 X



Trimming line appearance 1000X

元素	重量	原子	
	百分比	百分比	
C K	54.86%	68.21%	
O K	26.29%	24.54%	
Al K	10.28%	5.69%	
Si K	2.03%	1.08%	
Fe L	0.21%	0.03%	
Pb M	6.33%	0.46%	
总量	100.00%		

Composition



3. Summary : Grind and perform SEM composition analysis on products with good laser trimming lines and products with intentionally trimmed residues. A small amount of lead content is found in line grooves of products with OK trimming lines (less than 5%, as resistance layer contains lead, there will be traces of powder residues after trimming, resulting in lead content in the measurement). A higher amount of lead content is found in trimming line grooves of products with residues (more than 5%).

§5 . Conclusion

Based on above analysis, products with OK trimming line and products with trimming line residues all have a certain amount of lead content. Products with OK trimming lines have a low lead content in trimming grooves (<5%), while products with residual trimming lines have a relatively higher lead content in trimming grooves (>5%). When the powder amount reaches a certain level and the usage environment is relatively humid, resistance values may become lower. It is recommended that customers take protective measures in sensitive areas of such environments or circuits.