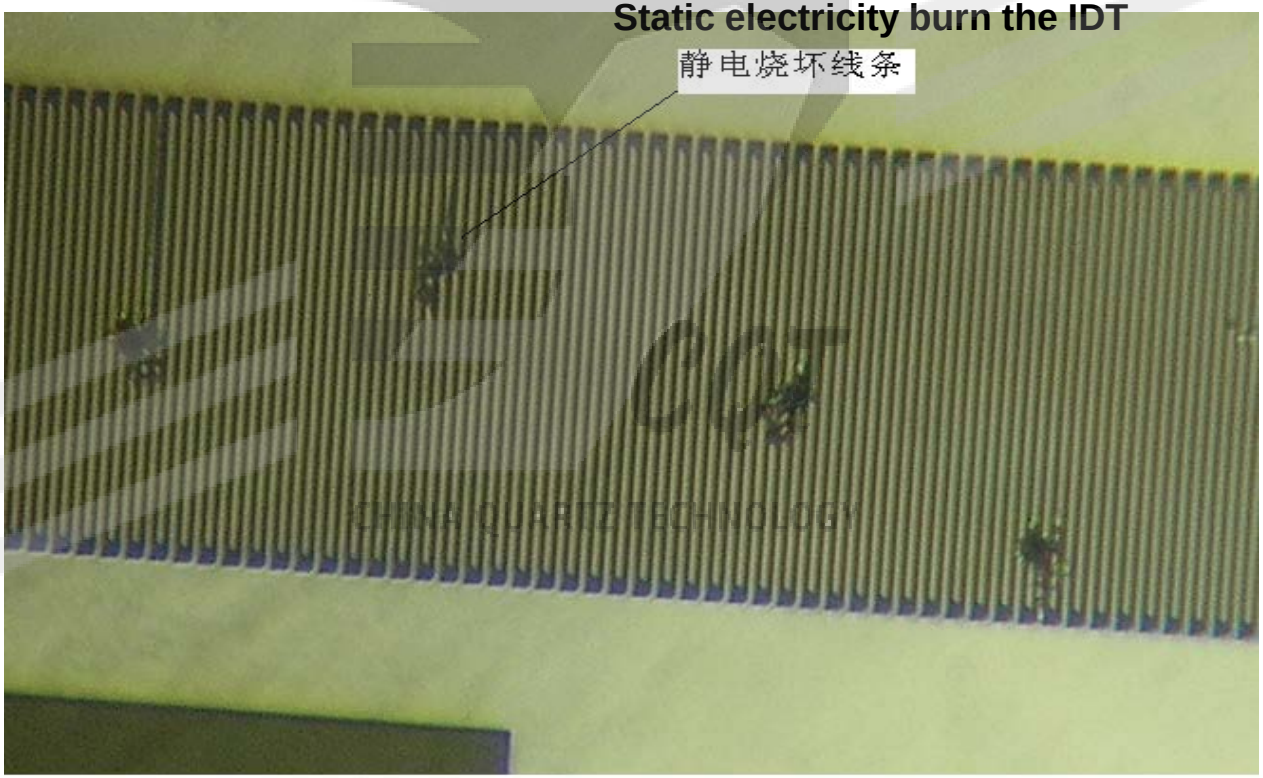
铌酸锂、钽酸锂单晶片黑化机理

LN LT wafer Pyro-free Introduction

研究背景 Background

- 钽酸锂晶体多功能：压电、铁电、热释电、电光、非线性光学. LT wafer have multifunction: piezoelectric, ferroelectric, pyroelectric, electro-optic, non-linear optics
- LT热释电系数高达23×10-5 C/m2•K,损伤晶片（如开裂、微畴反转）,烧毁叉指电极,器件热噪声；外延膜龟裂，降低外延膜性能 Pyroelectric coefficient of LT wafer reach up to 23x10-5 C/m2.K, will damage the wafer(eg. cracking, microdomain reverse), burn the IDT, cause device thermal noise, and outer film chap, lower the performance of epitaxial film
- 常规LT晶片的透明性会使背面形成漫反射，降低了光刻精度 Transparency of common LT wafer will cause the diffuse reflection on backside, reduce the accuracy of photo-etching

Static electricity burn the IDT



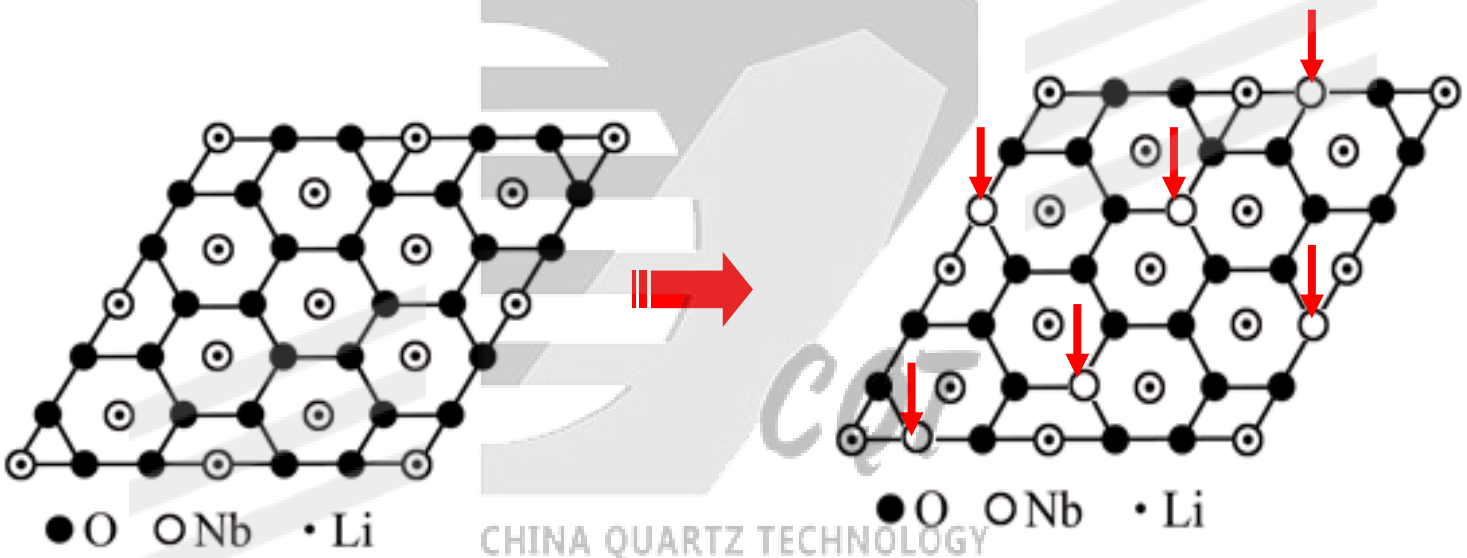
研究背景 Background

- 常用声表器件减少静电危害办法：
- 设计短路线条、静电中和技术、慢的工艺升降温、区域极化 、背面镀光吸收膜等 The common methods used by SAW device to reduce static electricity hazards: design short circuit IDT, static electricity neutralization technology, slow down the speed of warm up and cool down, area polarization, plate the light absorbing film on the backside, etc.
- 缺点：
- 生产效率降低，操作难度加大，器件热噪声仍在
  Disadvantages: production efficiency lower, operation difficulty higher, device thermal noise remain

产品设计原理

- LN、LT具有极性较强的结构，温度的剧变会产生较强的静电场 LN, LT have strong polarity structure, the sudden change in temperature will cause a strong electrostatic field
- 高温化学还原处理会产生大量的氧空位，提高载流子浓度，增加DC电导率，大的静电场难以建立；光吸收增强 High temperature chemistry reduction treatment will cause large amounts of oxygen vacancy, enhance carrier concentration, increase DC conductivity, difficult to set up large electrostatic field, light absorption strengthen
- 对还原后的晶片“正火”，有利于保持高温相 Normalizing the after-reduction wafer, will do good to keep the high temperature phase

还原机理 Pyro-free mechanism



$LiNbO_3 + xH_2 \Rightarrow LiNbO_{3-x} + xH_2O$

$LiTaO_3 + xH_2 \Rightarrow LiTaO_{3-x} + xH_2O$

电阻（导）率测量

Resistivity(Conductivity) measurement

- PC68型数字高阻计

  Model PC68 Digital high resistance meter
- 同成分白片 White wafer
  - LT 10^{14}～10^{16} Ω•cm
  - LN 10^{13}～10^{15} Ω•cm
- 还原黑片 Black wafer
  - LT 10^{10}～10^{12} Ω•cm
  - LN 10^{10}～10^{11} Ω•cm

500V 室温 50 ～ 75%

500v room temperature 50-75%