氟化电缆线的 TGA-FTIR 联用分析

目的 测试的目的是确定 ETFE 电绝缘材料热分解的时候是否有侵蚀金属连接件的腐蚀性化合物形成。

Purpose The aim of this measurement was to determine whether corrosive compounds that could attack the metallic connectors were formed during the thermal decomposition of ETFE electrical insulation material.

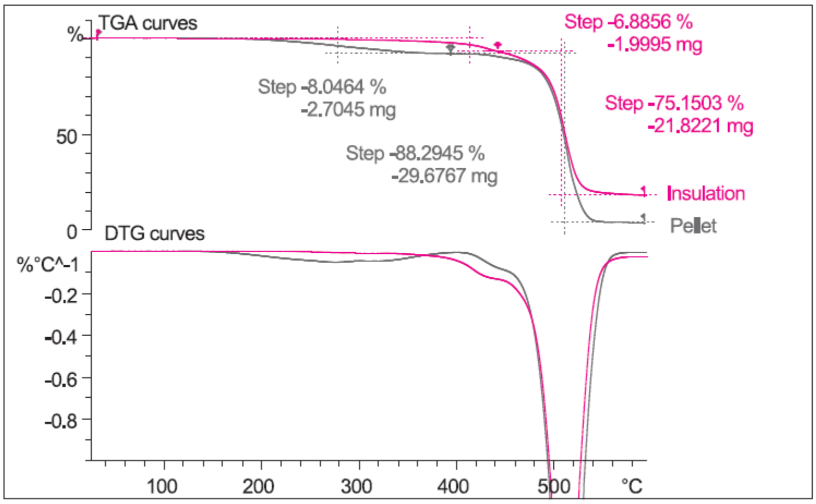
样品 ETFE(乙烯/四氟乙烯共混物)颗粒和绝缘层。

Sample ETFE (ethylene / tetrafluoroethylene copolymer) pellet and insulation.

条件

Conditions

测试仪器:	**Measuring cells:**
TGA 与尼高力 Nexus FTIR 联用	TGA coupled to a Nicolet Nexus FTIR
坩埚: 70μl 氧化铝坩埚,无盖	**Pan:** Alumina 70 μl, without lid
样品制备:	**Sample preparation:**
颗粒(33.610 mg)未经过处理。金属丝是从电缆上取下(29.038 mg)。	No preparation for the pellet. The metal wire was removed from the cable(29.038 mg)
TGA 测试:	**TGA measurement:**
以 20K/min 的速率从 25℃ 升温到 600℃。	Heating from 25℃ to 600℃ at 20 K/min.
气氛: 氮气,50 ml/min	**Atmosphere:** Nitrogen, 50 ml/min

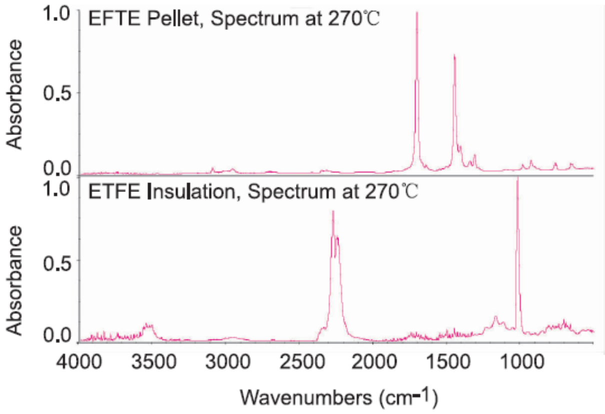


解释 ETFE 基材料的分解呈现两个失重台阶。颗粒几乎完全分解,只留下了 3.6% 的残余物。绝缘材料的残留重量为 21.2%,这说明其含有填料。

Interpretation The degradation of the ETFE-based material exhibits two weight loss steps. The pyrolysis of the pellet goes almost to completion leaving a residue of just 3.6%. The residual weight of 21.2% measured for the insulation material indicates that it contains a filler.

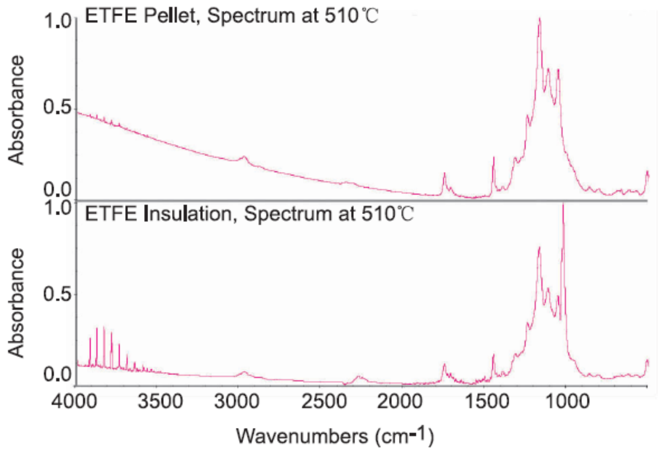
颗粒样品在270℃的第一个台阶的DTG曲线的峰非常明显。两个样品的一阶微商曲线均在420℃展示了一个较小的分解过程。

The peak in the DTG curve corresponding to the weight loss in the first step at 270℃ is much more pronounced in the case of the pellet. The derivative curves of both samples indicate that a minor process takes place at 420℃.



解释 两个样品的组分和分解行为是明显不同的。绝缘材料第一个失重(在270℃的DTG峰)显示了腈基(2300 cm^{-1} ~2200 cm^{-1})的存在，1025 cm^{-1}处较强的吸收带是由于卤代烷键C-F的存在。然而颗粒样品第一个失重峰对应的光谱在1450 cm^{-1}和1750 cm^{-1}显示了烷基醛的吸收带。

Interpretation The composition and degradation behavior of both samples are markedly different. The first weight loss (DTG peak at 270℃) observed with the insulation shows the presence of nitrile group (2300 cm^{-1} ~2200 cm^{-1}) and a strong band at 1025 cm^{-1} due to the alkyl halide bond C-F. The spectrum from the first weight loss peak of the pellet however displays absorption bands at 1450 cm^{-1} and 1750 cm^{-1} suggesting an alkyl aldehyde.



解释 第二个失重台阶(510℃的DTG峰)期间记录的IR光谱表明氟化烷(1500 cm^{-1} ~1000 cm^{-1})的存在。绝缘材料光谱在1025 cm^{-1}

Interpretation The IR spectra recorded during the second weight loss steps (DTG peak at 510℃) indicate the presence of alkyl fluorides (1500 cm^{-1} ~1000 cm^{-1}). The relative intensity of the alkyl fluoride band at 1025 cm^{-1} in the spectrum of the insulation is still strong. It is

处的氟化烷吸收带的相对强度仍然较强。值得注意的是可以观察到绝缘材料加工过程中生成的氟化氢（4000 cm^{-1} ~3500 cm^{-1}），但是这个特征谱在颗粒样品的谱图中并不清晰。

important to notice that hydrogen fluoride (4000 cm^{-1} ~3500 cm^{-1}) is produced during the processing of the insulation material, but that this characteristic pattern was not clearly present in the spectra from the pellet.

计算
Evaluation

	颗粒 Pellet	绝缘材料 Insulation
第 1 个台阶 First step	8.1% 醛、烷烃 aldehyde, alkane	6.9% 氟化烷烃、腈 alkyl fluoride , nitrile
第 2 个台阶 Second step	88.3% 氟化烷烃 alkyl fluoride	75.2% 氟化烷烃、氟化氢 alkyl fluoride, hydrogen fluoride
残留物 Residues	3.6%	21.2%

结论　鉴别了从颗粒和经过加工的绝缘材料中逸出气体的主要官能团。前面讨论中提到的吸收带显示原材料的加工影响了腐蚀性化合物氟化氢的形成。结果表明研究的绝缘材料与金属连接器是不相容的。

Conclusion　The main groups of gases evolved from the pellet and the processed insulation material have been identified. The absorption bands mentioned in the foregoing discussion show that the processing of the raw material influences the formation of corrosive compounds, namely hydrogen fluoride. The results indicated that the insulation material investigated was not compatible with the metallic connectors.