

注册



商标

大气低温等离子体表面处理系统

*Low temperature plasma source for surface treatment at atmospheric pressure*

## **PTS-2000 型大气低温等离子体处理系统**

PTS-2000 series low temperature plasma source for surface  
treatment at atmospheric pressure

# 使用说明书 *User's manual*

智能控制 —— 模糊软件

Intelligent control —— fuzzy software

功率器件 —— I G B T

Power transistor —— I G B T

电路控制 —— D S P

circuit control —— D S P

外型美观 —— 结构简洁

attractive appearance —— compact configuration

维护便利 —— 模块结构

easy to maintenance —— modular configuration

Please refer to the manual in detail before installing, operating and debugging.

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安装，操作或调试设备前，请先详细阅读本说明

## 一 技术简介

低温等离子体中粒子的能量一般为几个至几十电子伏特,大于聚合物材料的结合键能(几个至十几电子伏特),完全可以断裂有机大分子的化学键而形成新键;但远低于高能放射性射线,只涉及材料表面,不影响基体的性能。处于非热力学平衡状态下的低温等离子体中,电子具有较高的能量,可以断裂材料表面分子的化学键,提高粒子的化学反应活性(大于热等离子体),

## 1 Technique Introduction

The energy of particles in low temperature plasma is in the range from several electron volts to several dozens of electron volts, larger than the bond energy of polymer materials, which can have the chemical bond of organic macromolecules split and form new bonds. But the energy is much lower than high-energy radiation, only influencing material surface not substrate performance. Electrons in low temperature plasma under non-thermodynamic equilibrium status are of high energy, which can have molecule chemical bonds on the material surface split and improve particles' chemical reaction activity. While neutral particles'

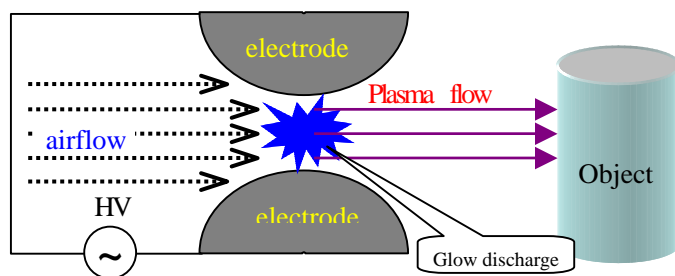


Figure 1

而中性粒子的温度接近室温,这些优点为热敏性高分子聚合物表面改性提供了适宜的条件。通过低温等离子体表面处理,材料表面发生多种的物理、化学变化,或产生刻蚀而粗糙,或形成致密的交联层,或引入含氧极性基团,使亲水性、粘结性、可染色性、生物相容性及电性能分别得到改善。在适宜的工艺条件下处理材料表面,使材料的表面形态发生了显著变化,引入了多种含氧基团,使表面由非极性、难粘性转为有一定极性、易粘性和亲水性,有利于粘结、涂覆和印刷。

temperature is approximate to ambient temperature. These advantages can provide proper conditions for thermo-sensitive polymer surface modification. There are many physical or chemical changes on material surface by low temperature plasma surface treatment. The surface may become coarse by etching, or form compact cross linked tier, or introduce oxy polar groups, which can improve hydrophilic nature, coherence, chromaticity, bio-compatibility and electrical performance respectively. Having material surface treatment with proper technique can have significant form changes of the material surface and introduce various oxygen groups. It can have the surface transferred from none polarity and coherence-proof to polarity, coherence and hydrophilic nature, which is beneficial to bonding, coating and printing.

目前各种薄膜的生产已经普遍采用电晕处理的方法来解决表面亲和性的问题。但由于电晕只能在两个相邻的平行电极间进行,且距离不能过大,所以电晕处理的方法不适合用来处理三维物体的表面极化问题。如果用火焰法来处理,其弱点是所有聚合物都是易燃和熔点低。当有机材料置于高温火焰下时,会因受高温的处理而变形、变色、表面粗糙、燃烧和散发出有毒气体。且处理工艺难以掌握。

三维物体表面的改性处理采用低温等离子体流处理工艺为最佳方案。其原理如图一所示。在电极两端施加交流高频高压,使两电极间的空气产生气体弧光放电而形成等离子区。等离子在气流的吹动下到达被处理物体的表面而实现对3D表面进行改性的目的。

## 二 主要技术指标

- 1、额定电压:  $\pm 20\%$ , 50Hz
- 2、额定功率: 1000VA
- 3、处理宽度: 10mm
- 4、等离子炬长度: 30mm
- 5、频率: 20kHz
- 6、处理效率: 100~300mm/s
- 7、气源压力:  $> 0.3\text{kg}$
- 8、流量:  $1\text{m}^3/\text{min}$
- 9、主机体积:  
 $400(\text{W})\times 630(\text{H})\times 320(\text{D})\text{mm}^3$
- 10、重量: 20kg
- 11、使用环境  
温度:  $-10^\circ\text{C} \sim +50^\circ\text{C}$ ;  
相对湿度:  $<93\%$ ;  
大气压力: 86 ~ 106kPa
- 12、贮存环境  
温度:  $-25^\circ\text{C} \sim +55^\circ\text{C}$   
相对湿度:  $<93\%(40^\circ\text{C})$   
大气压力: 86 ~ 106kPa

At present corona discharge is often used to solve surface affinity problems by various kinds of film productions. But corona discharge is not suitable to treat three-dimensional objects because corona can only be used among two neighboring parallel electrodes and the distance should not be too big. Flame plasma treatment is also not suitable because all polymers are combustible and of low melting point. When organic materials are in high temperature flames, they would be of distortion, color change, coarse surface, combustion and giving out poisonous gas. In addition, it is hard to master the treatment technique.

Low temperature plasma current treatment technique is the optimal scheme for three-dimensional objects' surface modification, with the principal of having high voltage with high frequency on two electrodes, so as to form plasma by having arc discharge between the two electrodes. The plasma can reach treated objects' surface by air current blowing, so as to realize three-dimensional objects' surface modification.

## 2 Technique Parameters

- 1.1 Rated voltage:  $\pm 20\%$ , 50Hz
- 1.2 Rated power: 1000VA
- 1.3 treating width: 10mm
- 1.4 Length of plasma torch: 30mm
- 1.5 Frequency: 20kHz
- 1.6 Treating rate: 100~300mm/s
- 1.7 Gas pressure:  $> 0.3\text{kg}$
- 1.8 Rate of gas flow:  $1\text{m}^3/\text{min}$
- 1.9 Dimensions:  
 $400(\text{W})\times 630(\text{H})\times 320(\text{D})\text{mm}^3$
- 2.0 Weight: 20kg
- 2.1 Desired operating environment  
Temperature:  $-10^\circ\text{C} \sim +50^\circ\text{C}$ ;  
Relative humidity:  $<93\%$ ;  
Atmospheric pressure: 86 ~ 106kPa
- 2.2 Desired storage environment  
Temperature:  $-25^\circ\text{C} \sim +55^\circ\text{C}$   
Relative humidity:  $<93\%(40^\circ\text{C})$   
Atmospheric pressure: 86 ~ 106kPa

### 三 安 装

### 3 Installation

#### 1、PTS-2000 结构

#### 1) Structural representation of PTS-2000



图 1. PTS-2000 设备外观图

- |             |                            |
|-------------|----------------------------|
| 1. 电源输入     | 1.1 Power supply, AC220V   |
| 2. 电源开关     | 1.2 Power switch           |
| 3. 交流电压表    | 1.3 AC Voltage meter       |
| 4. 交流电流表    | 1.4 AC Current meter       |
| 5. 喷头连接电缆   | 1.5 Connection cable       |
| 6. 输出控制插座   | 1.6 Output control plug    |
| 7. 地线接线柱    | 1.7 Earth connection       |
| 8. 流量计      | 1.8 Airflow meter          |
| 9. 等离子体喷头   | 1.9 Plasma nozzle          |
| 10. 机械手连接夹头 | 1.10 Manipulator fixture   |
| 11. 喷射输出触电  | 1.11 Plasma adsum juncture |
| 12. 电源指示灯   | 1.12 indicator light       |

#### 2、喷头的安装

#### 2) Install nozzle

- |  |   |
|--|---|
| (1) 将喷头安装在机械手上，并用适当的固定措施使喷头上的高压电缆、地线和气管不受强力拉扯、摩擦和尖锐物体的刺划 | 1.1 Place the nozzle into the Manipulator, some fixation measures should be employed to avoid unwanted pull, friction or scrape of high voltage cable, ground line and gas pipe |
| (2) 调整喷嘴和被处理工件之间的距离使其为 10mm ~ 15mm                       | 1.2 Adjust the distance between the nozzle and treated objects within the range of 10mm ~ 15mm  |

### 3、主机的安放

- 1、主机需要水平放置
- 2、设备工作时，主机的排风窗口不能有物体遮挡

### 4、设备的连接

- 1、将设备地线接线柱和大地地线连接
- 2、将主机电源线和 AC220V 电源相连接

### 5.控制插座和机械手控制电路的连接

将附件输出控制插头插入输出控制插座 6 上并旋紧锁紧螺母。两根控制线和机械手的控制电路连接。控制方式为通断控制，接通时等离子体喷射，断开时无等离子体喷射。机械手的控制元件可以使用继电器或开关等元件进行控制。

## 四 操作步骤

- 1、输出控制处于断的状态即待机状态，将电源开关 2 向上推至 ON 位置（向下推至 OFF 位置为关机），设备即处于待机工作状态
- 2、使输出控制处于通的状态，喷头将喷射出等离子体，即可处理工件
- 3、设备正常工作时，喷头有等离子体输出时交流电流表有约 3~4A 的电流

### 3) Install mainbody

- 1.1 The mainbody should be placed on a flat and solid surface, avoid leaning
- 1.2 The window of the fan should not be covered when the plasma source is working

### 4) Connection

- 1.1 Connect the earth connection to the earthed system
- 1.2 Connect the power cable to AC220V power

### 5) Connection of components of output power control with the control circuit of manipulator

Insert the output control plug firmly into the output control socket, secure the plug with a screw, connect the two control wires with the control circuit of manipulator. The control mode is on-off control, plasmas are ejected only if the circuit is closed. Relays or switches can be applied to manipulate control components of the manipulator

## 4 Operational procedures

- 1.1 Keep the output control on "off" mode, switch on the power, push the power switch up, (push down means off), the plasma source is prepared to work
- 1.2 Switch on the output control, and the plasmas are ejected at once
- 1.3 Once the plasma source begins to work normally and the plasmas are ejected, the current meter will indicate a current value in the range of 3~4A

- 4、主板上有一个设备状态指示红发光管。接通电源后设备正常时发光管长亮(与输出控制开关和气源流量无关);若出现 0.5 秒的间隔闪烁,则表示喷头和相关高压线有故障,如高压线断路、短路、接触不良等故障;若出现 2 秒的间隔闪烁,则表示主机风机有故障

## 五 注意事项

- 1、**PTS-2000** 为高压设备,无电工知识人员请勿打开机箱维护设备!
- 2、主机的地一定要可靠接(大地)地线!
- 3、无气或气源流量不足,设备将自动关机保护
- 4、喷头与主机间的高压电缆走线要自然,不能大角度弯曲
- 5、注意保护高压电缆,防止锐器划割伤高压电缆的硅胶
- 6、主机内的风扇、高压变压器等每 6 个月用刷子清除其表面的灰尘,环境恶劣的每 3 个月清除其表面的灰尘

## 六 附录

- 1、生产中常用测定湿润张力的混合液配方及可测定的表面湿润张力

- 1.4 There is a red LBD on the mainboard for indicating device status. The LBD is always bright when the plasma source works normally (independent on the switch of output control and the rate of airflow), however, if the light flashes discontinuously every 0.5 second, there may be some fault in the nozzle or the high voltage cable such as open circuit, short circuit or bad contact, discontinuous flash means some fault in the fan

## 5 Caution

- 1.1 The plasma source is accompanied with dangerous voltage, Please don't remove cover for reparation or adjustment purpose without authorization. Maintenance, if necessary, must be conducted by professional personnel
- 1.2 The earth connection of mainbody must be connected to the earth system
- 1.3 The plasma source will stop working automatically when the gas supply break off or the rate of gas flow is lower than the minimum level
- 1.4 Please don't bend the high voltage cable between the mainbody and the nozzle acutely
- 1.5 Please protect the high voltage cable against being scraped by keen-edged objects
- 1.6 Clean the fan and the high voltage transformer with soft brush every six months, or every three months on a grimy environment

## 6 Appendix

- 1.1 General components of mixed liquid for measuring the surface tension and the value of the surface tension

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甲酰胺 (Formamide, %)	乙二醇乙醚 (2-ethoxyethanol, %)	表面张力 Surface tension, dynes/cm)
42.5	57.5	36
48.5	51.5	37
54	46	38
59	41	39
63.5	36.5	40
67.5	32.5	41
71.5	28.5	42
74.5	25.5	43
78	22	44
80.3	19.7	45
87	13	48
90.3	9.7	50
93.7	6.3	52
96.5	3.5	54

### 2、一般材料表面电晕处理的要求

### 1.2 Requirements for corona surface treatment

项 目(items) 材料(material)\ 墨水(ink)	胶结/丝网印刷 (splice)			胶 印(offset)			涂布/复合 (besmear)		
	溶剂性 impregnant	水性 water	紫外 uv	溶剂性 impregnant	水性 water	紫外 uv	溶剂性 impregnant	水性 water	紫外 uv
LDPE	38-44	42-48	46-60	38-40	38-44	40-50	38-45	42-50	48-56
HDPE	38-44	42-48	46-56	38-40	38-44	38-50	38-44	42-50	48-56
PET	38-44	48-60	44-62	40-46	38-44	38-50	42-48	42-60	48-56
PP	38-44	42-48	44-60	38-40	38-44	40-50	38-44	42-50	48-56
PVC	38-44	42-48	42-60	38-40	38-44	38-44	38-45	40-48	48-56
EPDM	N/A	N/A	N/A	N/A	N/A	N/A	42-50	44-56	48-56
EVA	38-44	42-48	42-60	38-40	38-44	38-50	38-44	42-50	48-56

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