Advantages of IST-UV lamps in PVD applications

IST 紫外光灯在PVD 应用中的优点

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Outline of presentation
介绍纲要

- **Challenge of UV curing**
- 紫外光固化中的阻碍
- **Oxygen inhibition and how we can overcome it**
- 氧阻聚和我们如何克服氧阻聚？
- **UV Top coating and Base coating in PVD technology**
- 紫外光固化的顶涂和底涂在**PVD** 技术中的应用。
- **What is IST-UV lamps advantage in PVD**
- 什么是**IST** 紫外光灯在**PVD** 应用中的优点？
- **Conclusion**
- 结论

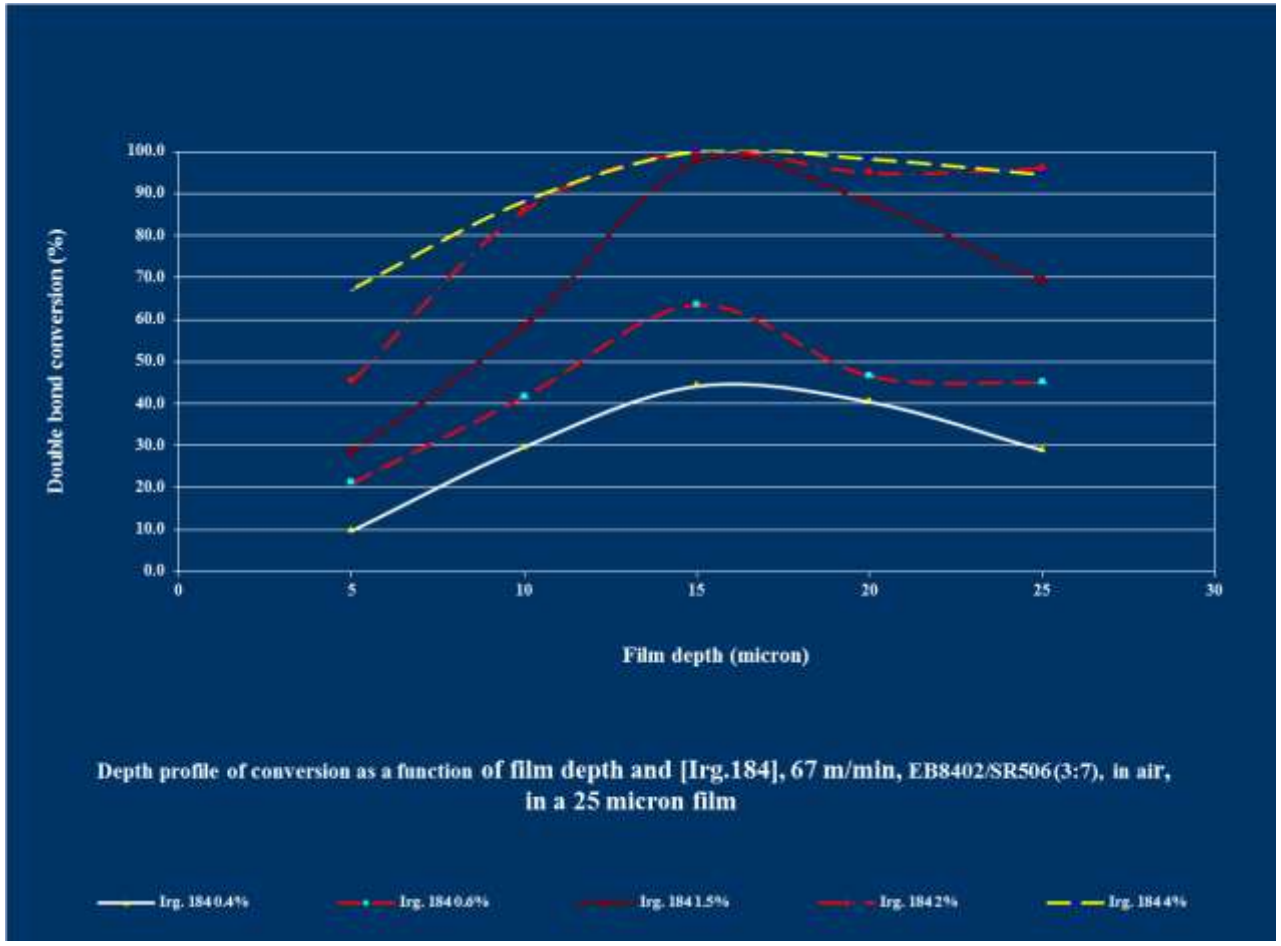
The Basic Challenges of UV Curing
紫外光固化的基本问题点

- **At the outmost layer of UV cured films:**
  在紫外光固化膜的最外层
  Oxygen Inhibition in Base coat and Top coat，
  氧阻聚在面涂和底涂 中的作用

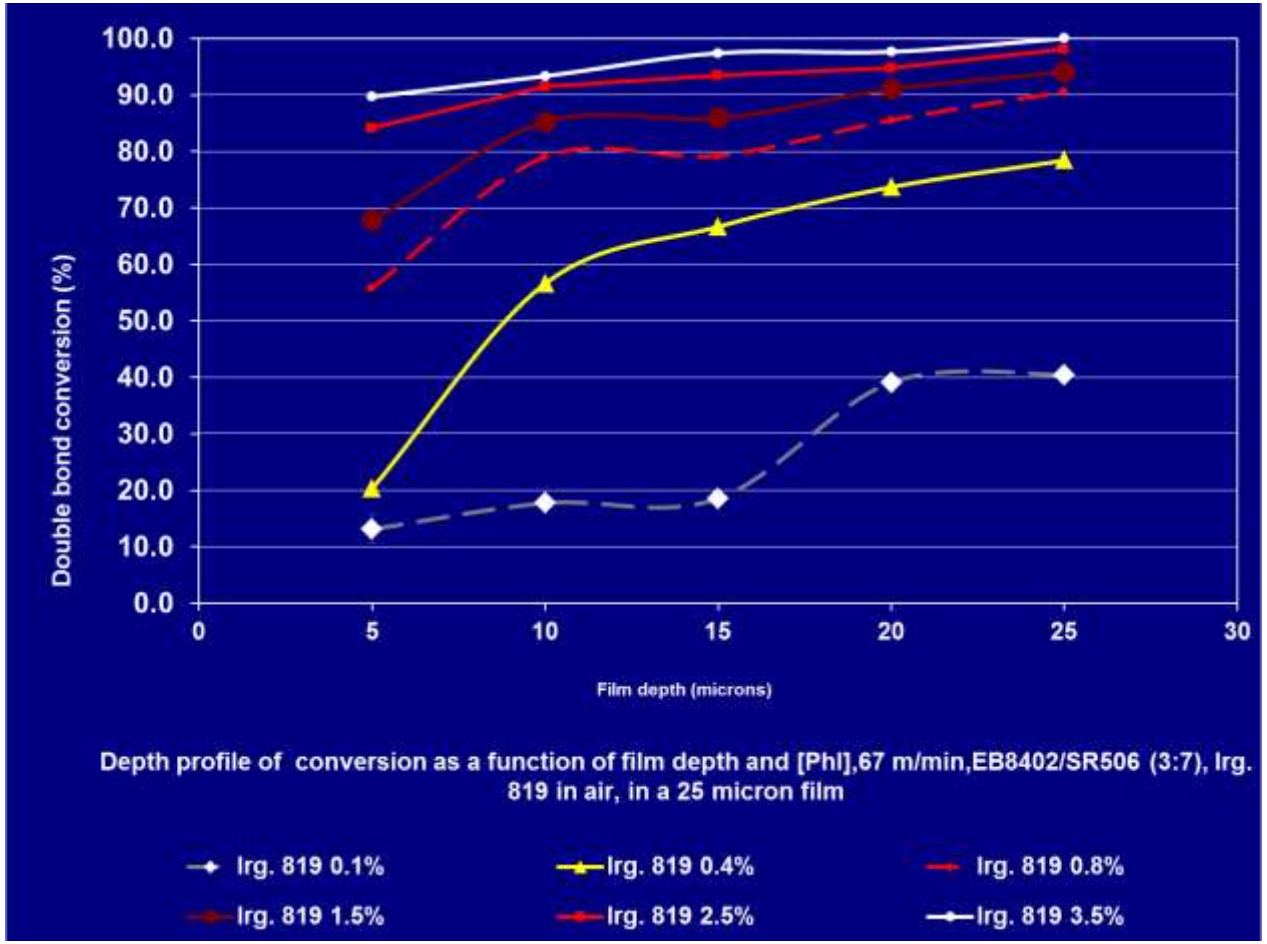
- **At the interface between UV cured films and substrates:**
  在UV固化膜和基材之间：
  Inner Filter Effect in UV embossing Coating, Adhesion/conformal coating
  在UV浮雕涂层，粘结 / 保型涂层中的内过滤效应

Irg. 184 as a PhI, cured by Microwave H lamp

184 作为光引发剂，用微波激发H灯固化



Irg.819 as a PhI, Cured by Microwave H lamp，
819作为光引发剂，用汞灯固化



Why Oxygen inhibition can happen?
为什么氧阻聚能够发生？

- **Oxygen stable state:** 氧气的稳定状态

  triple state with two unpaired electrons in two orbits and ready to react with free radicals from PhI (rate: 10K – 100K times faster)

  每一个轨道上有一个未成对电子，氧同自由基的反应速度，比同双键反应快一万到十万倍。

- **Dissolved O2 in monomers / oligomers is 1-2 mM**

  溶解在单体 / 预聚物中氧的浓度是**1-2mM.**

- **Oxygen can diffuse into films during the UV curing process and most diffuse will happen in top 10 microns,**

  在**UV** 固化过程中，氧可以渗透到被固化膜中，大部分渗透发生在顶部的**10**微米。

- **Oxygen inhibition will happen, using microwave UV lamps**

  既便使用微波**UV** 灯，氧阻聚仍会发生。

What Oxygen inhibition can do for your UV curing?
氧阻聚能对您的UV 固化作些什么？

- **Scavenging initiating radicals，**
  吞噬引发自由基。

- **Cause long induction period and reduce the rate of photo-polymerization，**
  引起长的诱导期和降低光聚合的速度
- **Increase [PhI] and cost of UV curable formulations**
  增加光引发剂的用量和配方成本

- **Obtain an un-uniform cured firm and reduced a long-term weather stability**
  得到一个不均匀的固化膜和降低常时间膜的稳定性

- **Introduce a lot of OH group into coating films**
  固化膜中引入许多**OH** 基团。

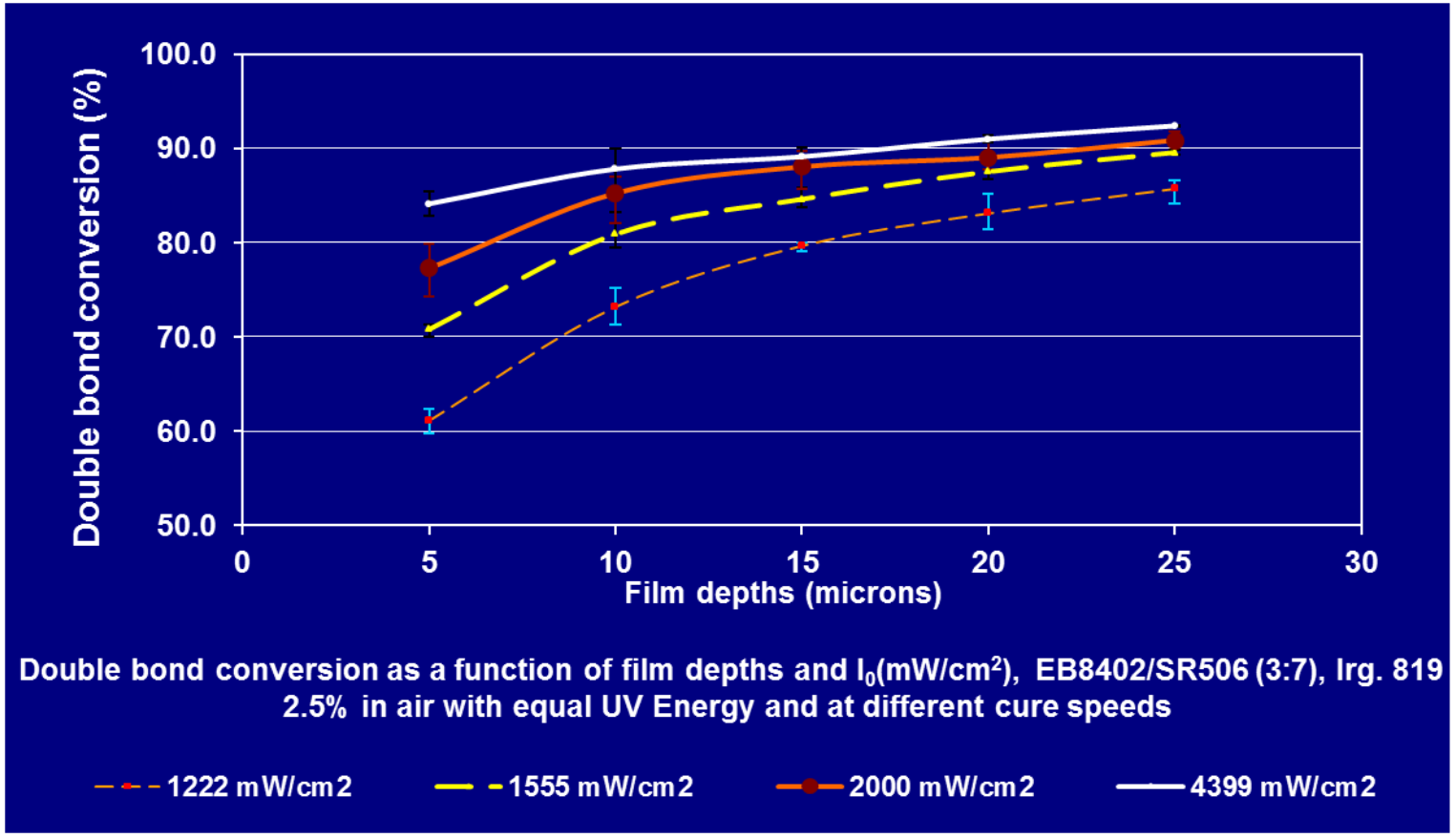
- **Directly result: surface tacky, very easily making finger print on surface，**
- 直接结果：表面发粘，很容易留下指纹印

How can we reduce oxygen inhibition?
我们如何降低氧阻聚？

- **To use BPh and organic tertiary amines or their mixtures**
  使用二苯甲酮，有机胺及它们的混合物
- **To add more photoinitiators (PhIs)**
  加入更多的光引发剂
- **To make UV curing in inert atmosphere or between laminate film, such as PET, PP, PE film**
  在堕性气氛下或夹层中固化，例如PET,PP and PE膜。
- **To reduce curing speed (increasing UV Dose)**
  降低固化速度（增加UV 剂量。
- **To increase UV light intensity**
  增加UV光强
- **To use UV lamps(IST-UV lamps) with more UVC output to match UV absorption of short wavelength PhIs，**
  使用具有更多UVC输出并同短波光引发剂UV吸收相匹配的UV灯(IST-UV 灯)

Example of increasing UV light intensity(mw/cm$^{2)}$ with same UV Dose(mj/cm^2),

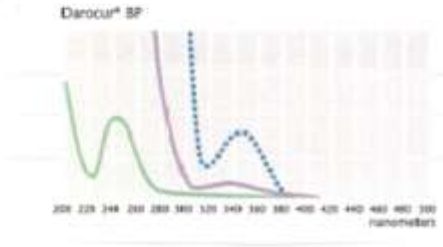
增加光强的例子，具有相同UV 剂量

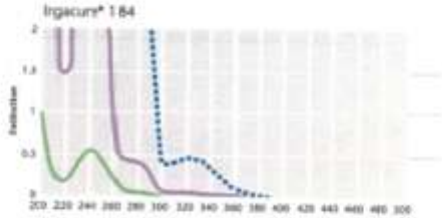


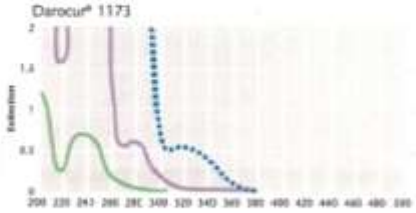
UV absorption of most widely used PhIs
最广泛使用的光引发剂的UV吸收

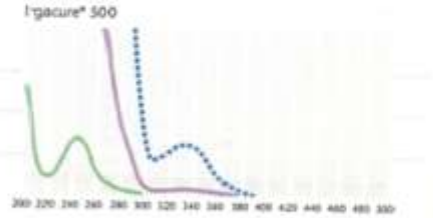
Some UV-Vis absorption spectra of PhIs in free radical photopolymerization

1. Clear coatings









Difference of UVC measurement Between F600 H(240 W/cm) and IST-UV H(200 W/cm) at 250-260 nm

在F600H和IST-H灯之间UVC的测量

- For curing of a clear coating， it´s important to have UV output in the UV-C range

  对于固化一个透明涂层，具有UVC的UV输出是重要的

- Microwave 600, 240 W/cm, v = 20 m/min approx. 100 mJ/cm²
- IST, BLK®-5, 200 W/cm, v = 20 m/min: approx. 180 mJ/cm² !
- IST, BLK®-5, 160 W/cm, v = 20 m/min approx. 140 mJ/cm² !
- Result: Higher efficiency of the IST lamp module having 40-80% more UVC!!!

  结论：IST 灯的高效率产生40-80%更多UVC

Oxygen Inhibition Vs base and top Coat in PVD application
氧阻聚在PVD应用面涂和底涂中的作用

- **1. Function of Base coat: smooth of plastics, Sealing(to prevent some air come out)**

  底涂的作用：平滑塑料表面，密封(防止气体逸出)，

- **Base coat: 12 microns, under influence of Oxygen inhibition，**

  底涂:12微米，在氧阻聚的影响之下。

  If we can not get a good surface curing: Soft surface, lose metal, lose vocuume
  ，如果我们得不到好的表面固化：表面发软，损失金属

- **2. Function of Top coat: Scratch resistance, looks nice**

  顶涂的作用：抗刮伤，看起来好看

  If we can not get a good surface curing: low scratch resistance, surface tacky,not looks nice

  如果我们得不到好的表面固化： 低抗刮伤能力，表面发粘，不好看，易吸尘

- **3. Solution: Using enhanced short UVC wavelength lamp, IST-UV lamps**

  解决方案：使用增强的UVC灯（IST-UV灯)

Advantage of IST-UV lamps in PVD application,
IST 紫外光灯在PVD 应用中的优点

- **1. Provide alternative solutions**
  提供另外的解决方案
- **2. Provide more UVC output**
  提供更多UVC输出
- **3. Good matching with short wavelength absorption of PhIs**
  很好的同短波长光引发剂匹配
- **4. Longer exposure timing, more UVC Dose**
  长的曝光时间，更多UVC剂量
- **5. For wide cured samples, provide uniform UV distribution**
  对于宽的被固化物，提供均匀的UV光分布
- **6. At certain case, we can cut the cost of UV lamps**
  在某些情况下，降低UV灯的成本
- **7. Less cooling noise**
  降低冷却噪音
- **8. High energy efficiency: 240 W/cm =200 W/cm**
  高的能量效率