



Technology Transition Workshop | *Alexandre Beaudoin & Brian Dalrymple*

History and Evolution of Physical Developer

Treatment on Porous Surfaces

- **Ninhydrin**
- **1,8-diazafluoren-9-one (DFO)**
- **1,2-indanedione**
- **Oil red O**
- **Magnetic powder**
- **Physical developer**

Treatment on Wet Porous Surfaces

- **Multimetal deposition**
- **Oil red O**
- **Physical developer**

History

- **Physical developer developed by the Atomic Weapons Research Establishment and the UK Home Office Scientific Development Branch**
- **Technique introduced in *Manual of Fingerprint Development Techniques* by Morris (editor)**
- **Several attempts to simplify the process over the years**
- **Last formula developed by Ramotowski et al. from the U.S. Secret Service**

Evolution of Formula

- **A lot of work has been done to simplify the process**
 - Many of the formulation changes give poor results
- **In those that work:**
 - There is an attempt to acidify the acid pre-wash to help remove CaCO_3 (calcium carbonate)
 - There is a change of the Synperonic N to the Tween[®] 20 to improve stability (by Ramotowski et al.)

What is Physical Developer (PD)?

- **Can detect fingerprints on wet and dry porous surfaces**
- **It's based on an oxidation-reduction reaction**
- **Could be used to develop salt traces from shoes on paper (more relevant for northern states where there is snow and, by extension, salt on the road)**

Pros of PD

- **Can develop very old fingerprints**
- **Can detect fingerprints not developed by oil red O**
- **The developed fingerprint is stable and stays visible for a long period**

Cons of PD

- **Destructive Technique**

- **Time consuming**
- **Expensive chemicals**
- **Complexity of application**
- **Monitoring of development during process**
- **Acid wash pre-treatment renders the paper weak and easy to damage**
- **Large quantity of glassware needed**
- **Requires VERY clean glassware**
- **Dirty method**

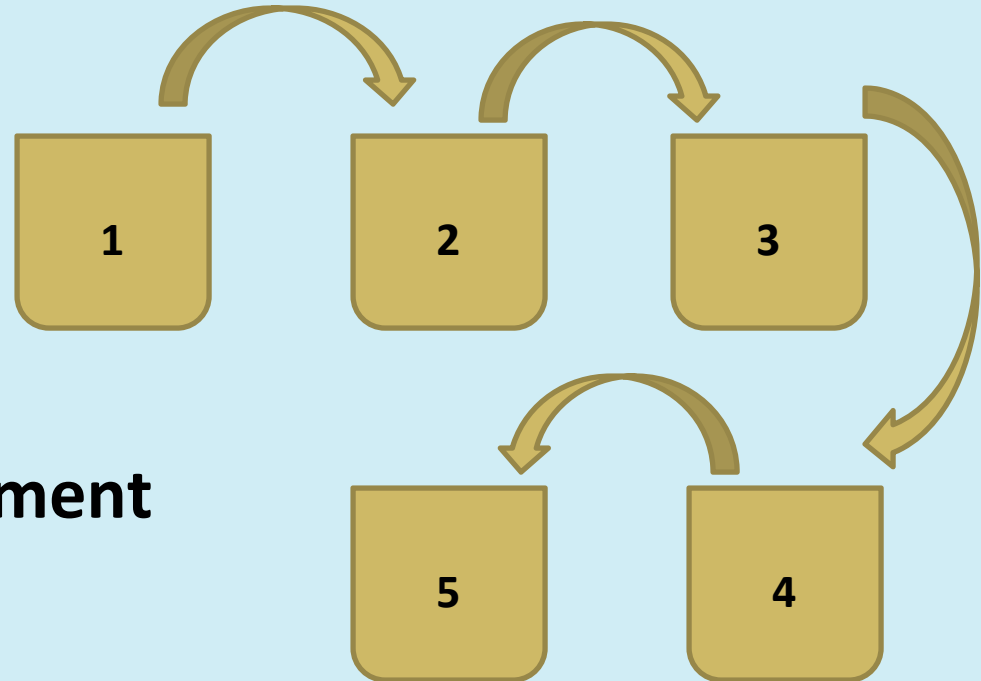
What is PD?



Materials and Methods

Six steps:

1. Rinse
2. Acid pre-wash
3. Rinse
4. Physical development
5. Fix solution
6. Drying



Materials and Methods

Preparation of Solutions*

- **Verification of Distilled Water**
 1. **To make sure distilled water is not corrupted, add some crystals of silver nitrate into 25 ml of distilled water.**
 - **If the water stays clear, distilled water is OK**
 - **If white milky material forms at the bottom of the container, distilled water must be changed**

*** For the physical developer technique, always use plastic pliers and glassware**

Materials and Methods

Preparation of Solutions

- **Remember**
 - **Always put acid into water, never water into acid**
 - **Putting water into acid gives an exothermic reaction (heat production) that could cause an explosion**
- **Keep in mind:**
 - **Acid in water: yes sir!**
 - **Water in acid: stupid!**

Materials and Methods

Preparation of Solutions

- **Redox Solution – combine:**
 - **30 g ferric nitrate**
 - **80 g ferrous ammonium sulfate**
 - **20 g citric acid**
 - **900 ml distilled water**

Materials and Methods

Preparation of Solutions

- **Detergent Solution – combine:**
 - 3 g n-dodecylamine acetate
 - 3 ml Tween[®] 20
 - 1 L distilled water
- **Silver Nitrate Solution – combine:**
 - 10 g silver nitrate
 - 50 ml distilled water

Materials and Methods

Preparation of Solutions

- **Malic Acid Solution – combine:**
 - 25 g malic acid
 - 1 L distilled water
- **Fix Solution**
 1. **Mix photo fixer and distilled water according to the manufacturer's instructions (usually 1 part of photo fixer for 7 parts of water).**
 2. **Add 10 ml of photo fix in the solution.**

Materials and Methods

Preparation of Solutions

- **PD Working Solution*** – combine:
 - **900 ml Redox Solution**
 - **40 ml Detergent Solution**
 - **50 ml Silver Nitrate Solution**

*** Should be used as soon as it is prepared!**

Materials and Methods

Procedure

- 1. Soak the document in a distilled water bath for 2 to 3 minutes.**
- 2. Remove the document from the distilled water bath and drain it.**
- 3. Place the document in the Malic Acid Solution (pre-wash) and keep immersed until no more bubbles form in the solution from the document.**
 - This step is used to get rid of the calcium carbonate in the paper that could ruin the physical developer reaction**

Materials and Methods

Procedure (continued) *

- 4. Remove the document from the Malic Acid Solution and drain it.**
- 5. Next, soak the document in a second distilled water bath for 2 to 3 minutes.**
- 6. Remove the document from the water bath and drain it.**

*** Between each tray, the plastic pliers must be soaked in distilled water**

Materials and Methods

Procedure (continued) *

- 7. Place the document in the PD Working Solution, being careful to monitor the treatment very closely. If you don't, fingerprints could be lost.**
 - If you used ORO before PD, pay close attention to the sites where the ORO has stained the paper, since there is a greater chance of finding fingerprints there**

*** Between each tray, the plastic pliers must be soaked in distilled water**

Materials and Methods

Procedure (continued) *

- 8. When the development of the fingerprint is sufficient, remove the document from the PD Working Solution and drain it.**
- 9. Immerse the document in the Fix Solution for 2 to 3 minutes to stop the reaction.**
- 10. Let the document dry in open air.**

*** Between each tray, the plastic pliers must be soaked in distilled water**

Principle of PD

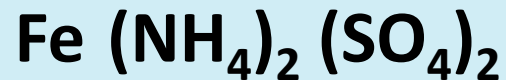
- **It's a fingerprint development technique based on an oxidation-reduction reaction**
- **Oxidation-reduction: spontaneous reaction where there is an electron transfer from one atom to another**
- **Reaction where oxidation and reduction take place simultaneously**
- **These two reactions taken separately have no basis in reality**

Ionisation

Silver nitrate →



Ferrous ammonium sulfate →



Ionisation

Silver nitrate → silver ions:



Ferrous ammonium sulfate → ferrous ions:



Oxidation and Reduction

- **Oxidation: chemical reaction where we lose an electron**



- **Reduction: chemical reaction where we gain an electron**

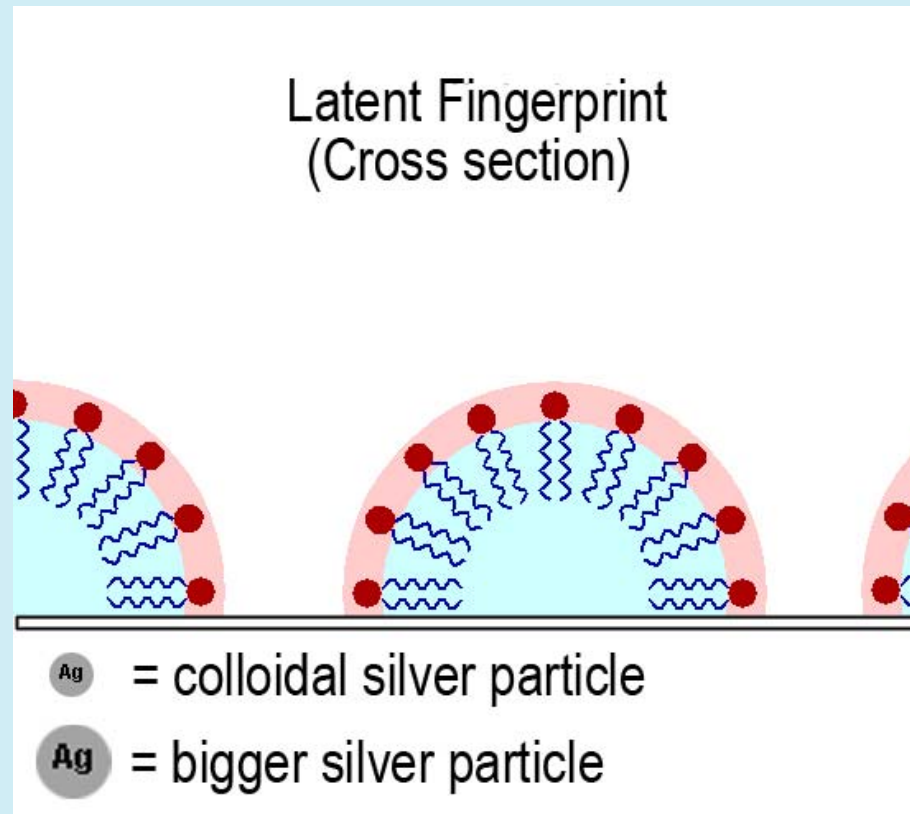


- **Equation: $\text{Fe}^{2+} + \text{Ag}^{+} \leftrightarrow \text{Fe}^{3+} + \text{Ag}_{(s)}$**

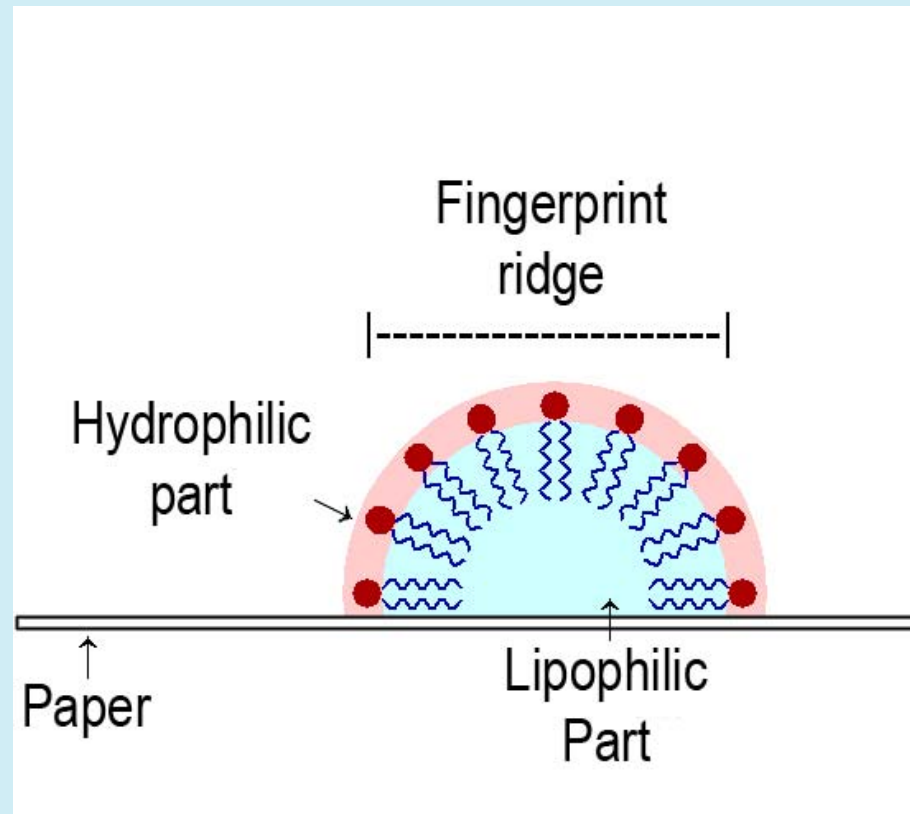
Oxidation and Reduction

- **During oxidation-reduction, the chemical compound that gives an electron is called the reductant**
- **The one that receives the electron is called the oxidant**

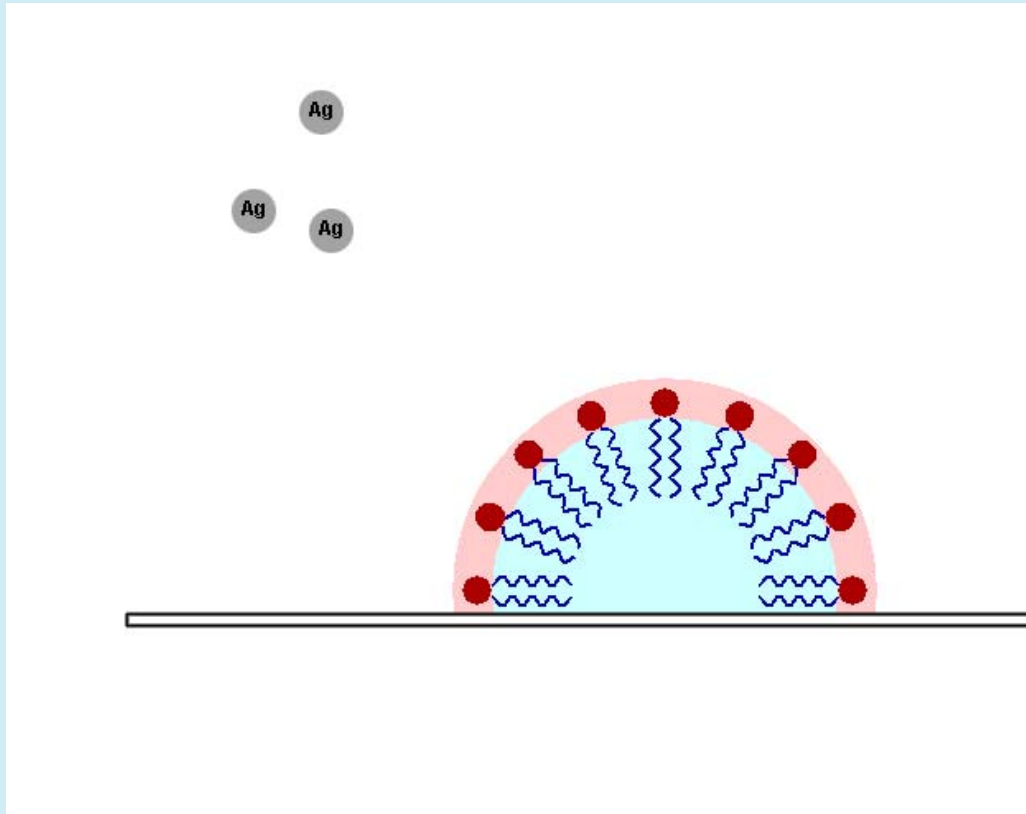
How Does PD Work on Fingerprints?



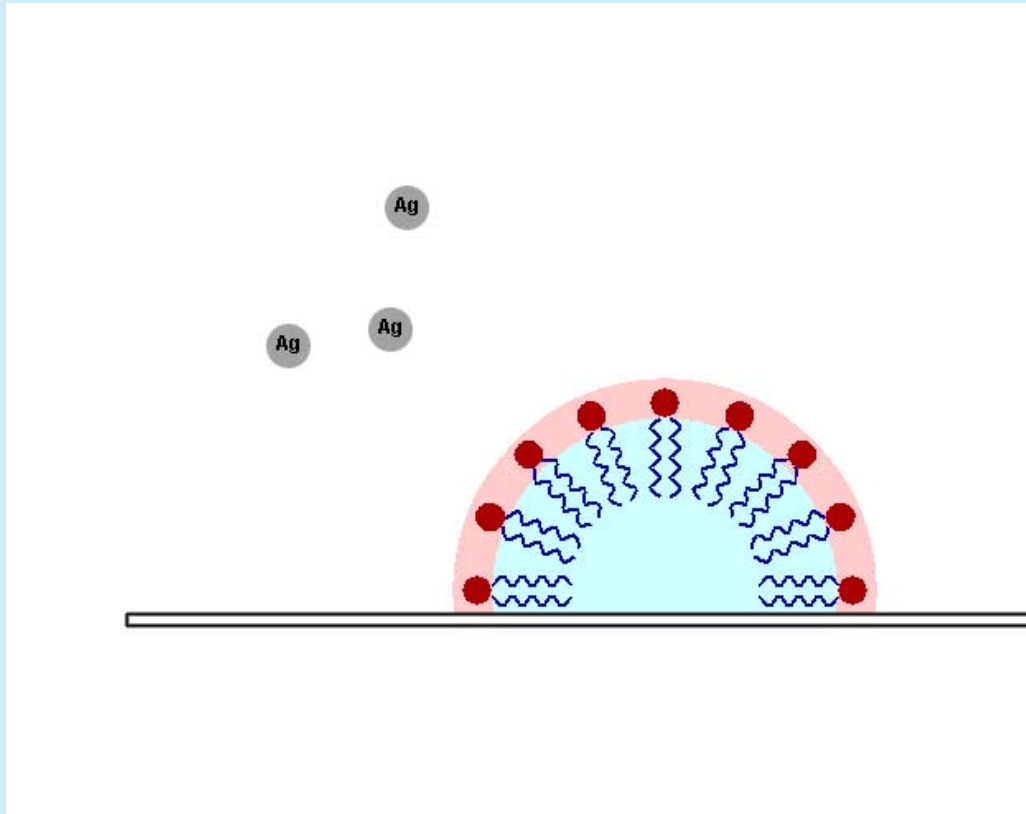
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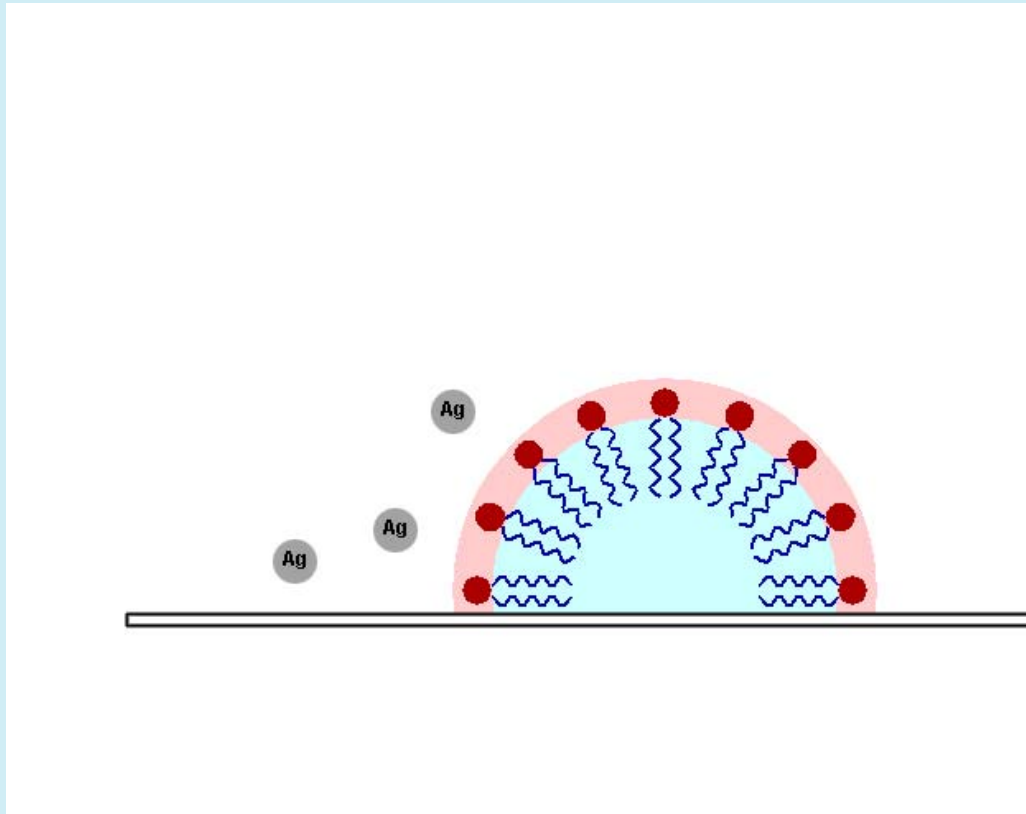
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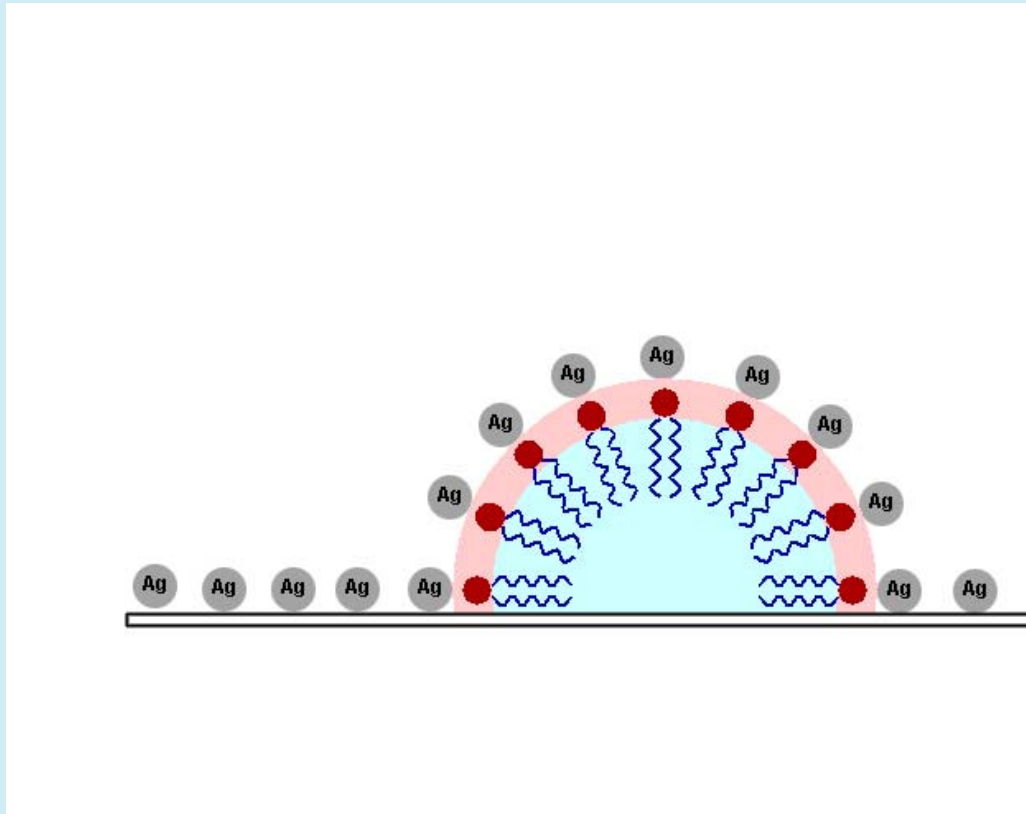
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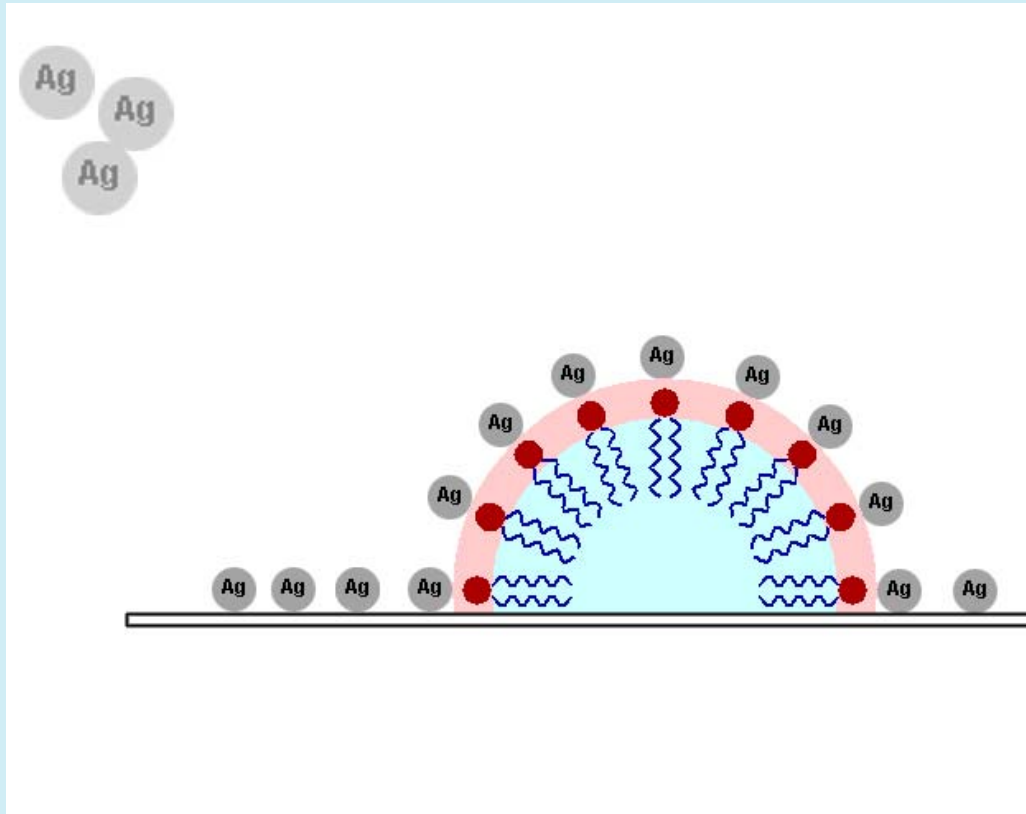
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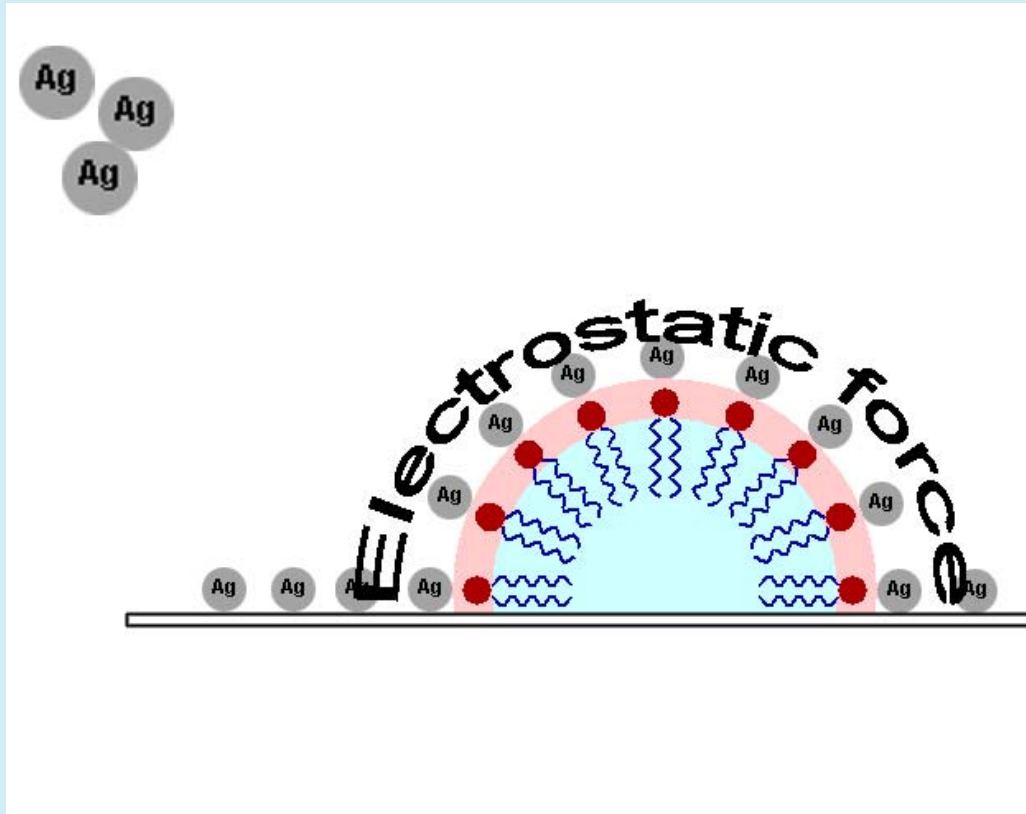
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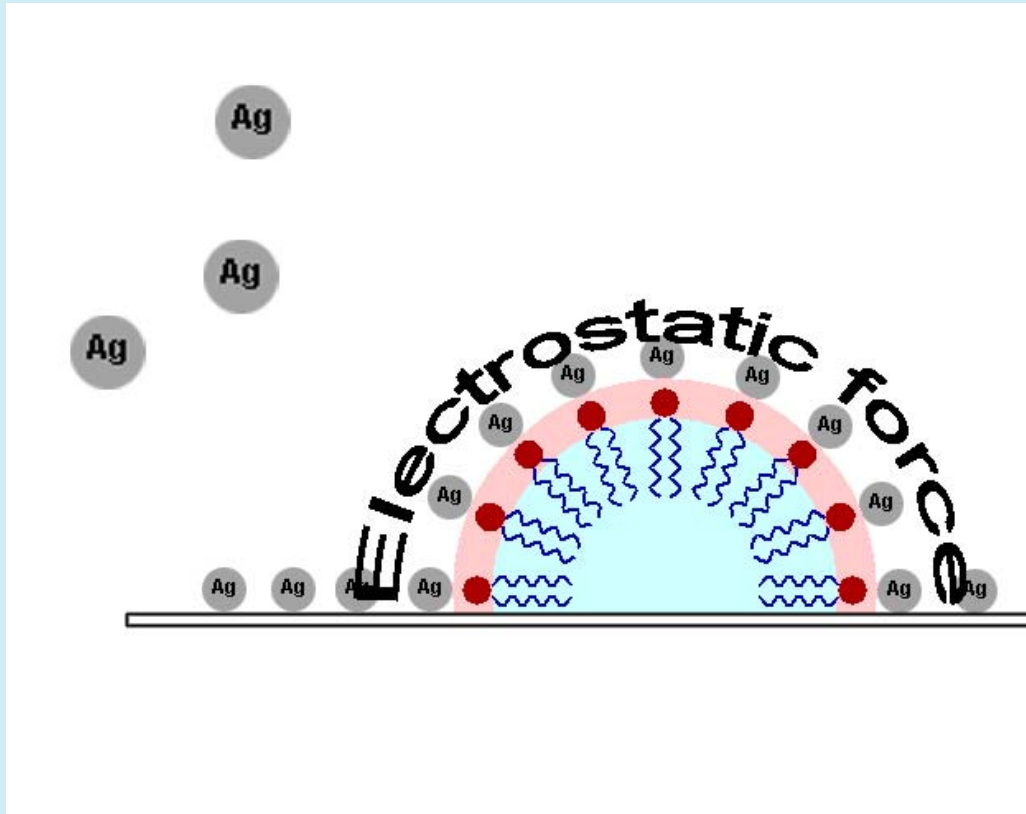
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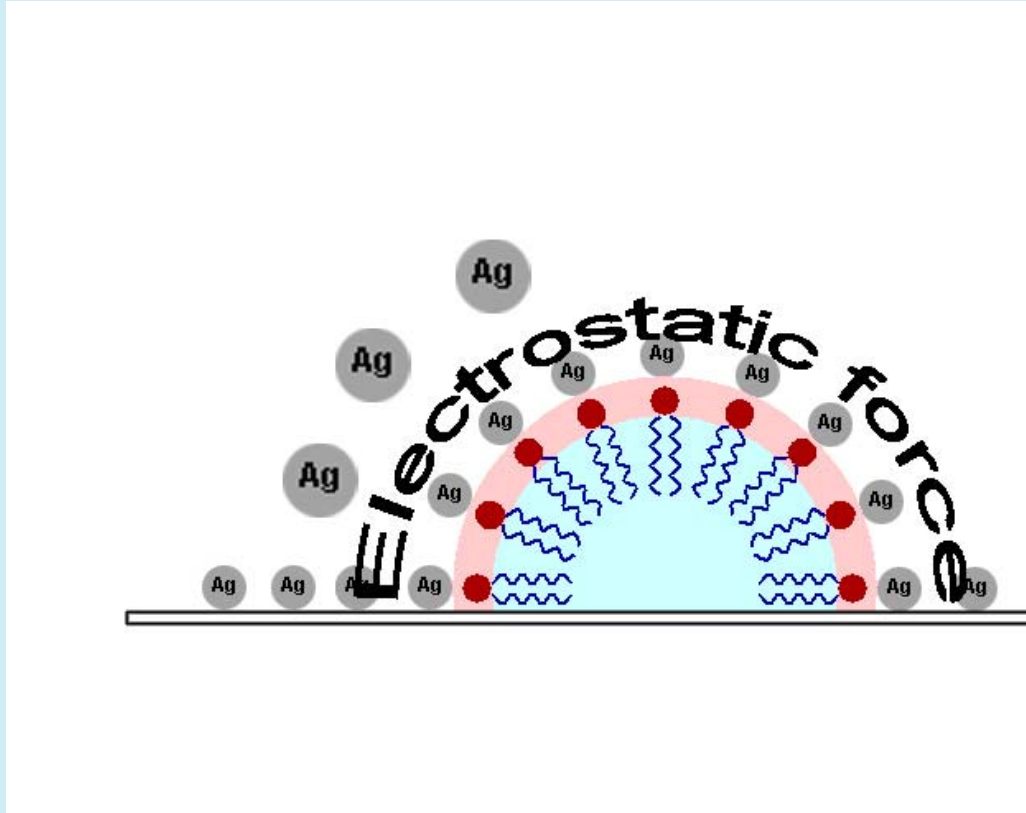
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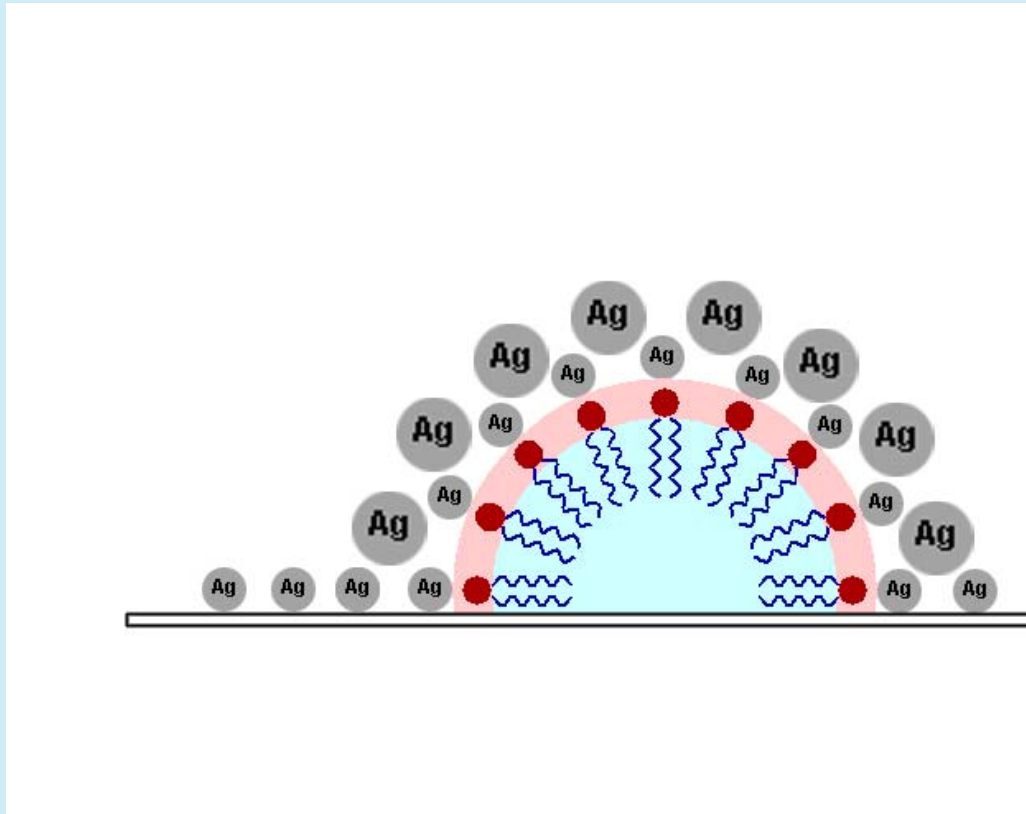
How Does PD Work on Fingerprints?



How Does PD Work on Fingerprints?



How Does PD Work on Fingerprints?



When Should I Use PD?

- **PD should be used on dry or wet porous surfaces**
- **PD should be integrated into your sequence on dry porous surfaces after oil red O**
- **Dry porous surface sequence could be:**
 - **DFO-NIN-ORO-PD**
 - **IND-ORO-PD**

When Should I Use PD?

- **PD should be integrated into your sequence on wet porous surfaces after oil red O**
- **Wet porous surface sequence should be:**
 - **ORO-PD**

Physical Developer After ORO



Conclusion

- **Physical Developer is a good technique for wet porous surfaces and dry porous surfaces**
- **You should practice the physical developer technique in order to be able to use it in casework**
- **Physical developer is especially good for very old fingerprints**
- **Physical developer should be used as the last and final technique, since it is DESTRUCTIVE**

Questions?

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Note: All images are courtesy of Alexandre Beaudoin.