Surface Modification of Carbon Black

Next Generation Inkjet Pigments

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Boston Chapter IS&T, May 2001

Outline

- Generation 1 Pigments
  - Simple diazonium treatment
  - Dispersion and Ink properties
- Generation 2 Pigments
  - Conceptual design
  - Secondary attachment
  - Polymer attachment
  - Properties
- Laser Quality

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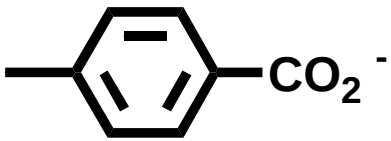
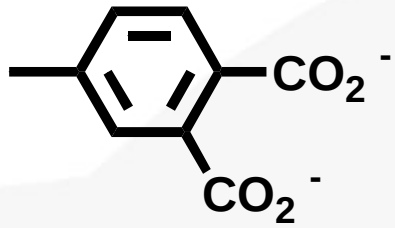
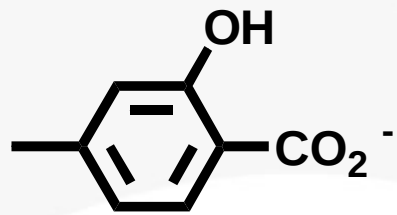
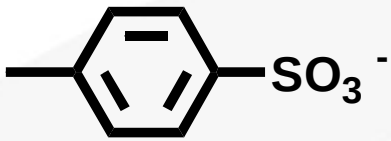
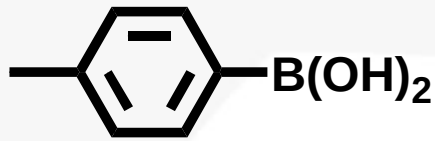
Some Basic Functional Groups

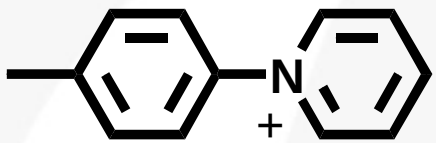


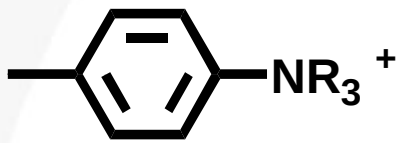


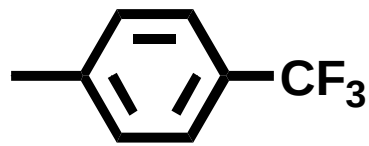


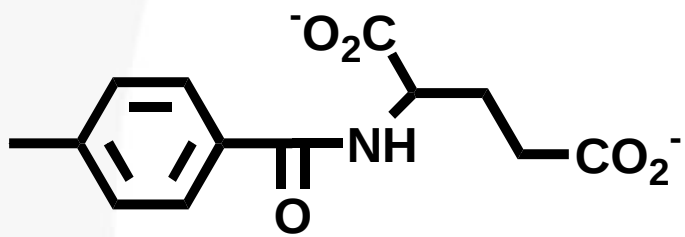












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Generation 1 Inkjet Pigments

- ✓ Light Stability
- ✓ Dispersion Stability- Charge and Particle Size
- ✓ Print Head Reliability- Purity
- ✓ High Optical Density
- ✓ Improved Intercolorbleed
- ✓ Improved Waterfastness

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Generation 1 Inkjet Pigments

- ✗ Highlighter Smear
- ✗ Wet Rub
- ✗ Dry Rub
- ✗ Dry Time

Optimizing these performance properties generally requires formulation with surfactants and polymeric additives

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Generation 2 Inkjet Pigments

Eliminate the need for ink additives...

Achieve all performance goals
through
surface groups.

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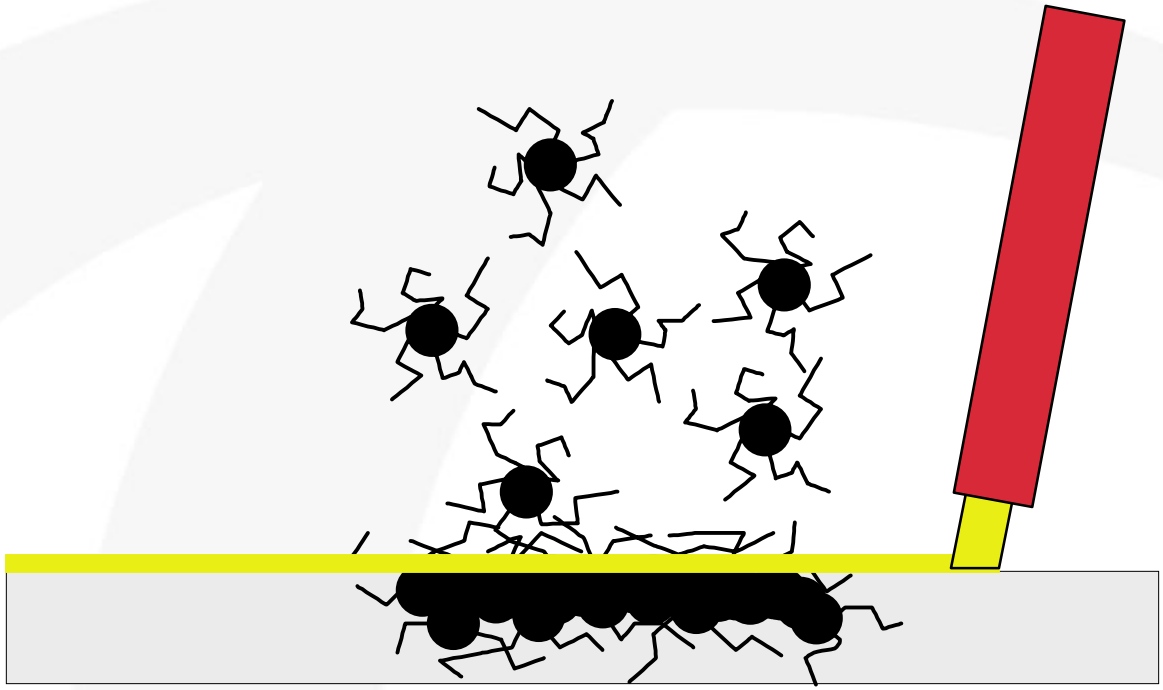
Network-Forming Groups Attached to Surface



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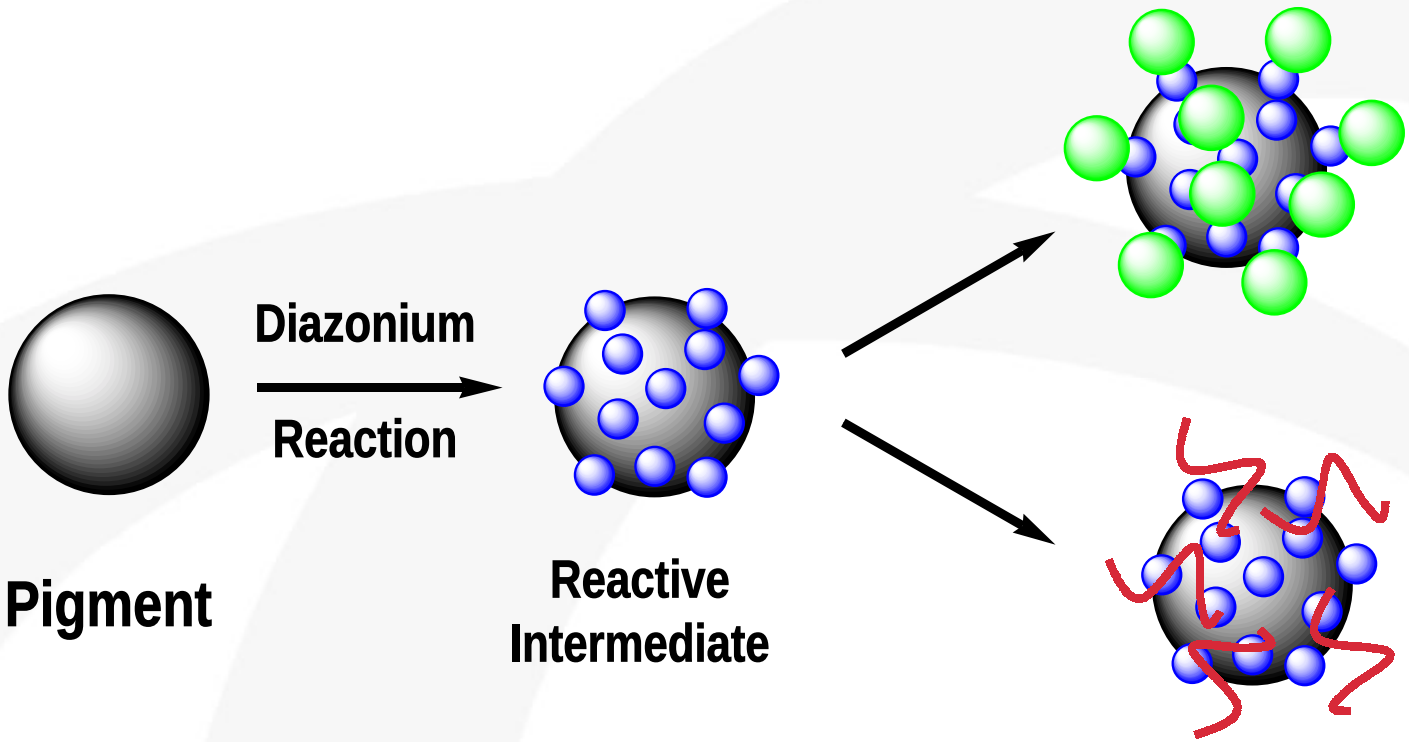
Secondary Surface Chemistry



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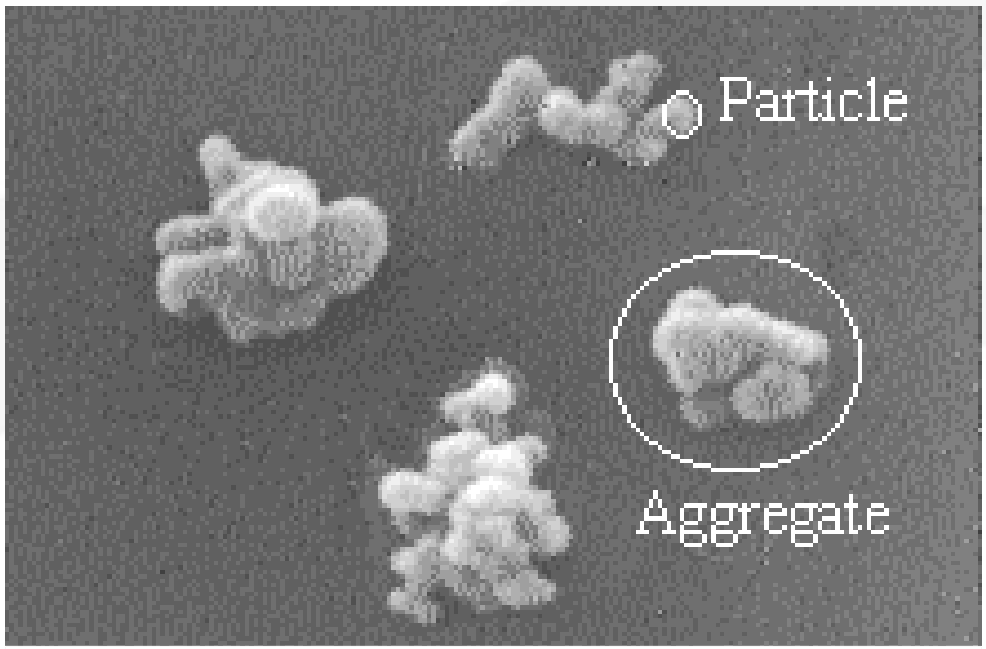
Carbon Black



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Secondary Surface Chemistry

- First group provides a “hook”
- Second group introduces the desired properties
- Now it’s possible to attach groups that are not compatible with diazonium chemistry
- Many variants
  - Condensation reactions
  - Coupling reactions
  - Addition-elimination reactions
  - Displacement reactions
  - Etc...

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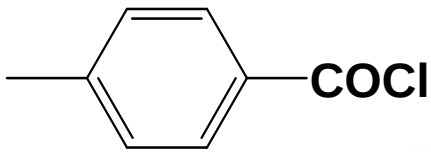
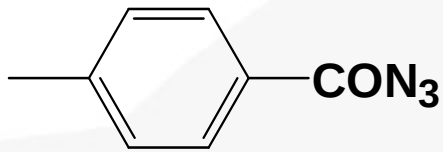
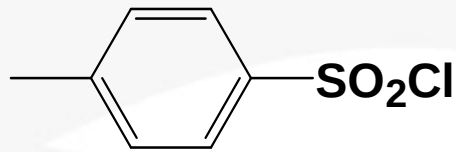
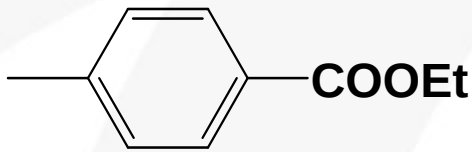
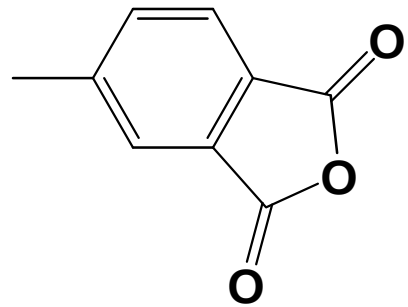
Reactive Surface Groups











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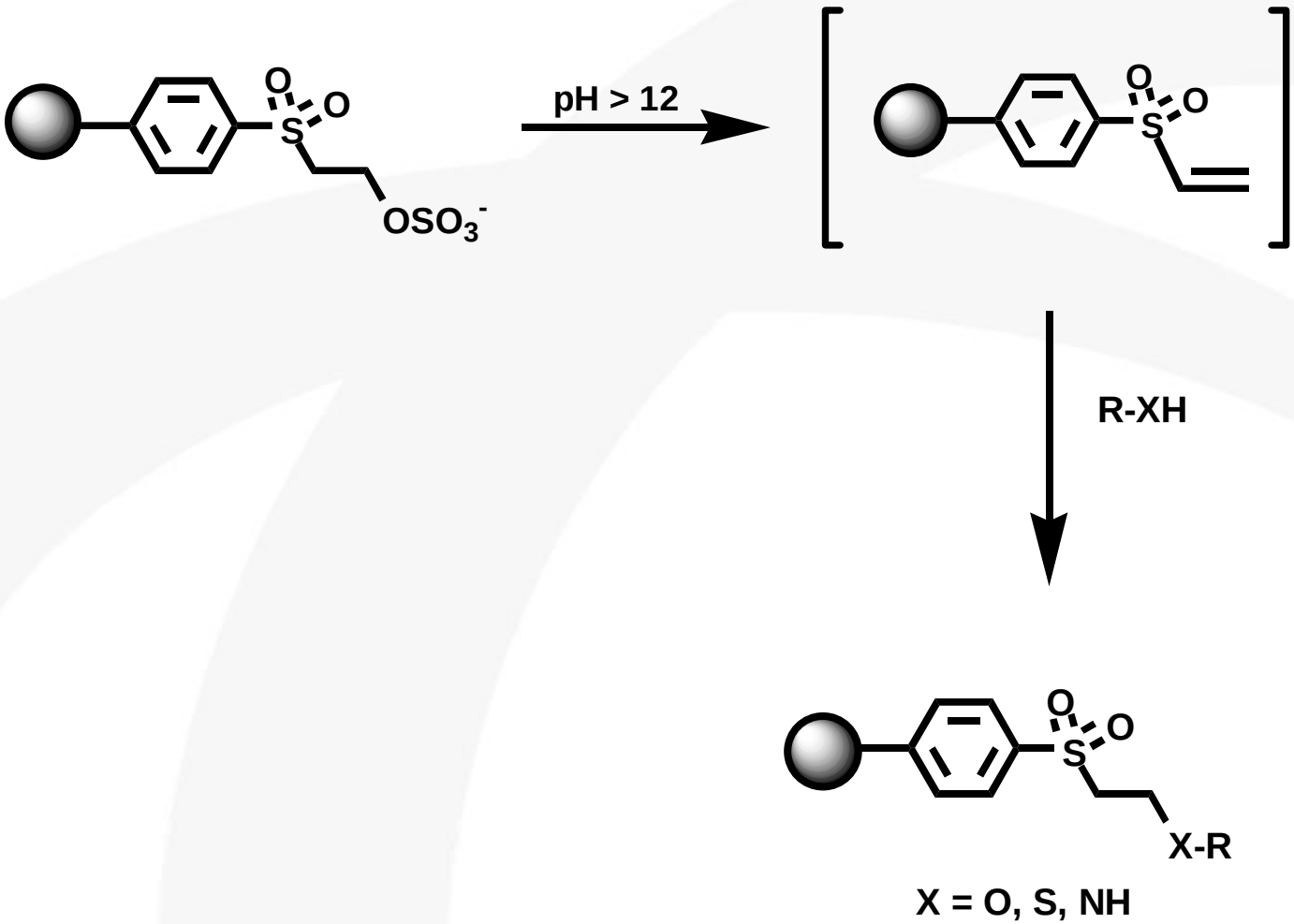
Reactive Functional Groups: Vinyl Sulphone



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Attachment via Vinyl Sulfone Surface

- Polyethylene imines
- Amino alcohols
- Dendrimers
  - Starburst
  - Astramols
- Polyols
  - Polyvinyl alcohol
  - Sorbitol
  - Sugars and Polysacharides
- Gelatin
- PEG, PPG
- Other polymers

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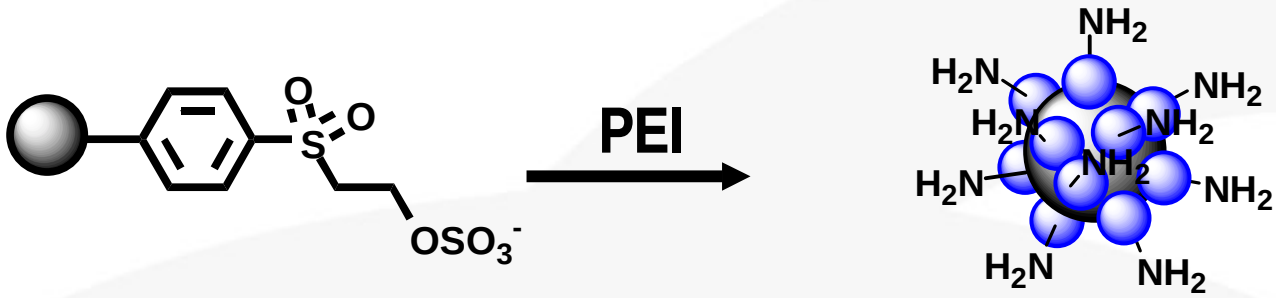
Polyethylenimine



- Highly cationic
- Waterfast in 5-10 minutes
- Improved smear
- Binds well to many surfaces

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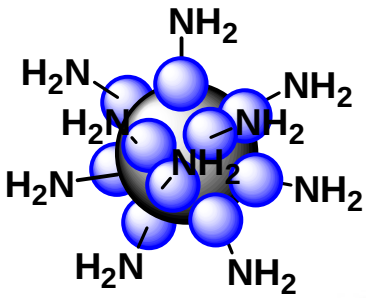
Reactive Functional Groups: Amine



Reaction with:

- Anhydrides
- Acid chlorides
- Lactones
- Active esters
- Alkyl halides
- Vinyl sulphones
- Polystyrene co-acrylic acid
- Polyacrylic acid
- Etc.

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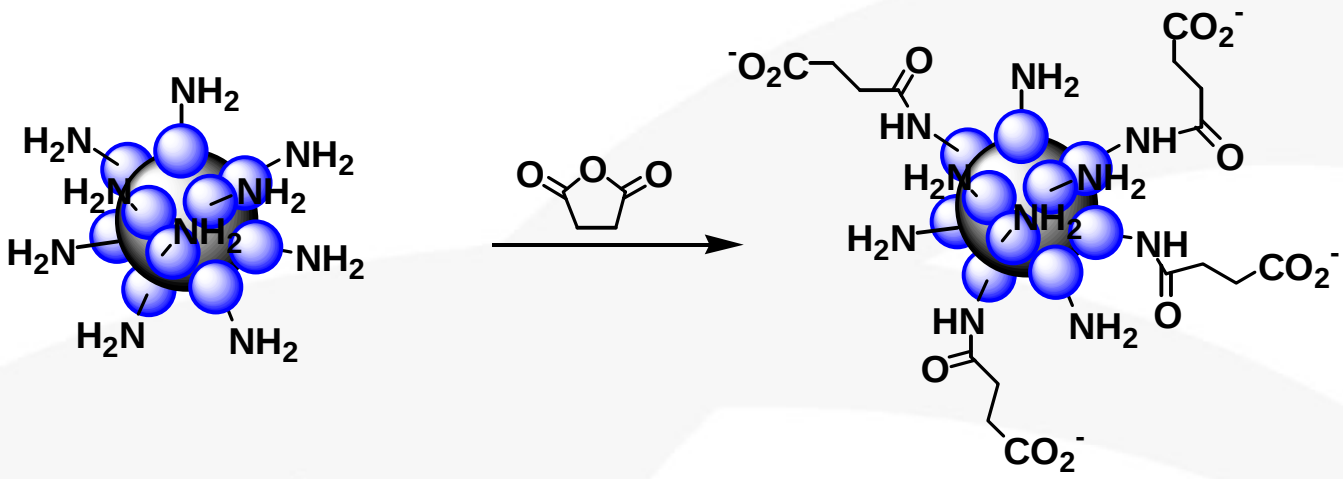
Succinic Anhydride



Amphoteric

- Adjust isoelectric point
- Formulation flexibility
- Optimize for specific media

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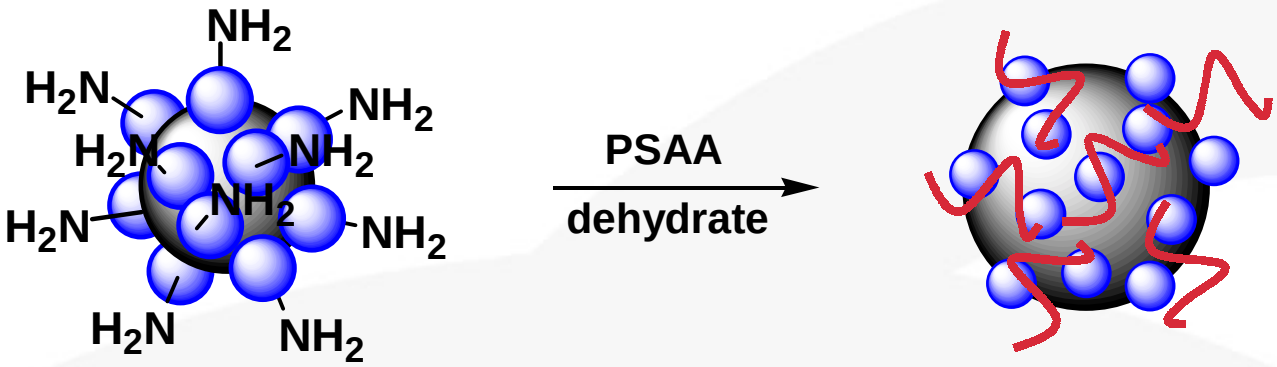
Polystyrene co-Acrylic Acid



- Covalent polymer attachment
- Excellent smear resistance
- Waterfast in 1 minute
- Very rub resistant
- Media independence

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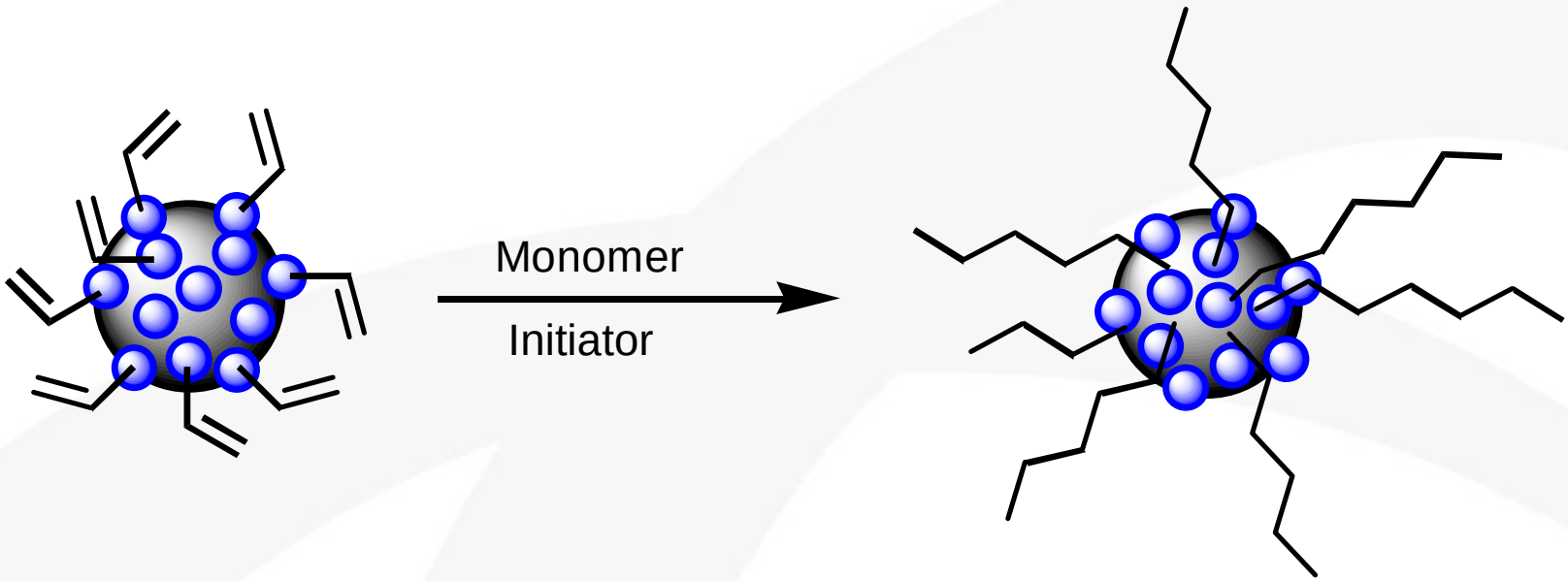
Reactive Functional Groups: Vinyl



- Grow polymers from surface
- Vary monomer mix

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Laser Quality Goals

- Print speed = dry time
- Print quality
  - OD, edge acuity, intercolorbleed, etc.
- Print durability
  - Waterfast, smearfast, rub resistant, etc.
- Printhead reliability

Generation 2 pigments are enabling!

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Thank You!

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