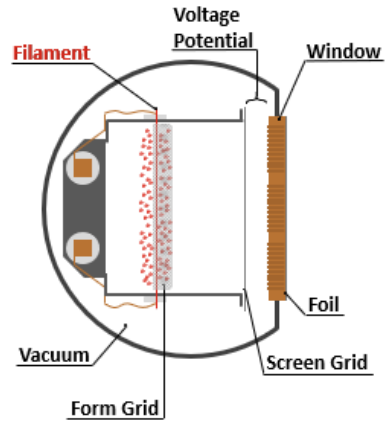
PCT
EBEAM AND INTEGRATION

Introduction to Ebeam

6.15.21

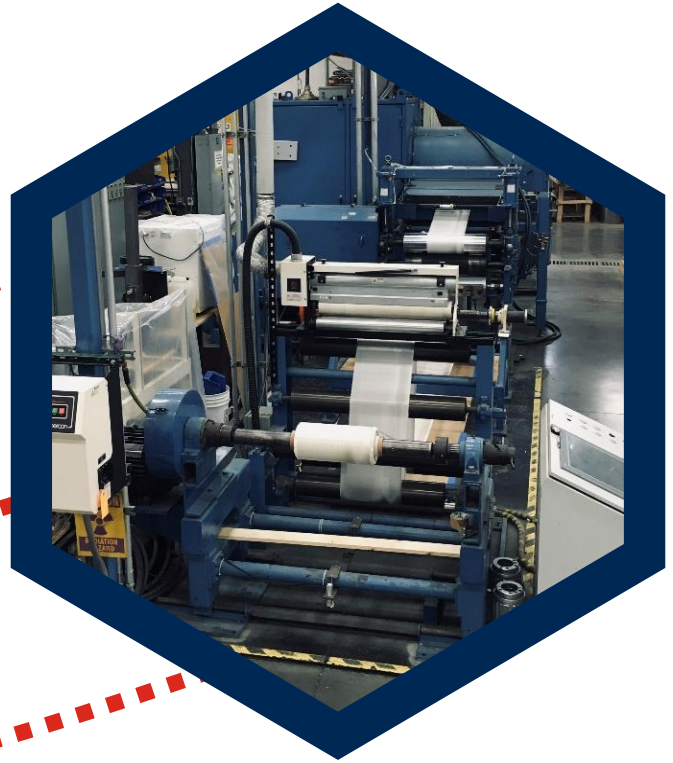
Outline



1. Ebeam Basics

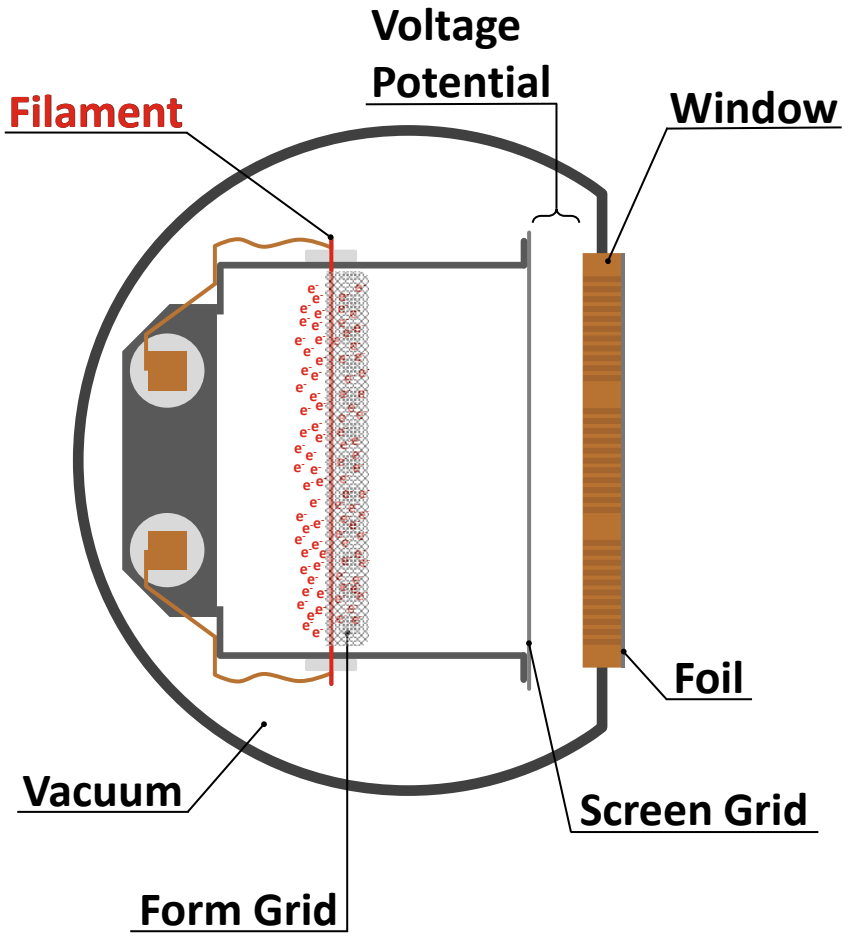
2. Ebeam Application Benefits

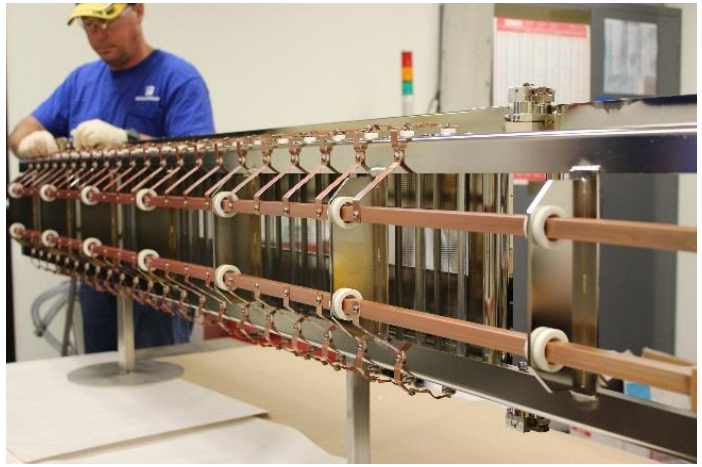
3. Equipment Design

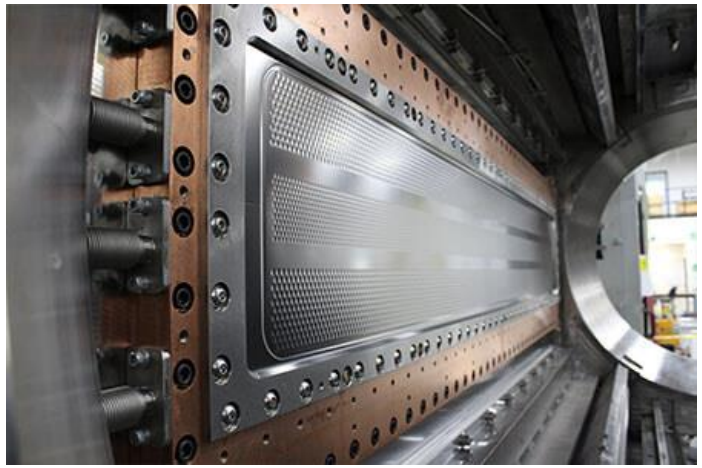


4. Application Development

An electron beam produces a curtain of accelerated electrons.







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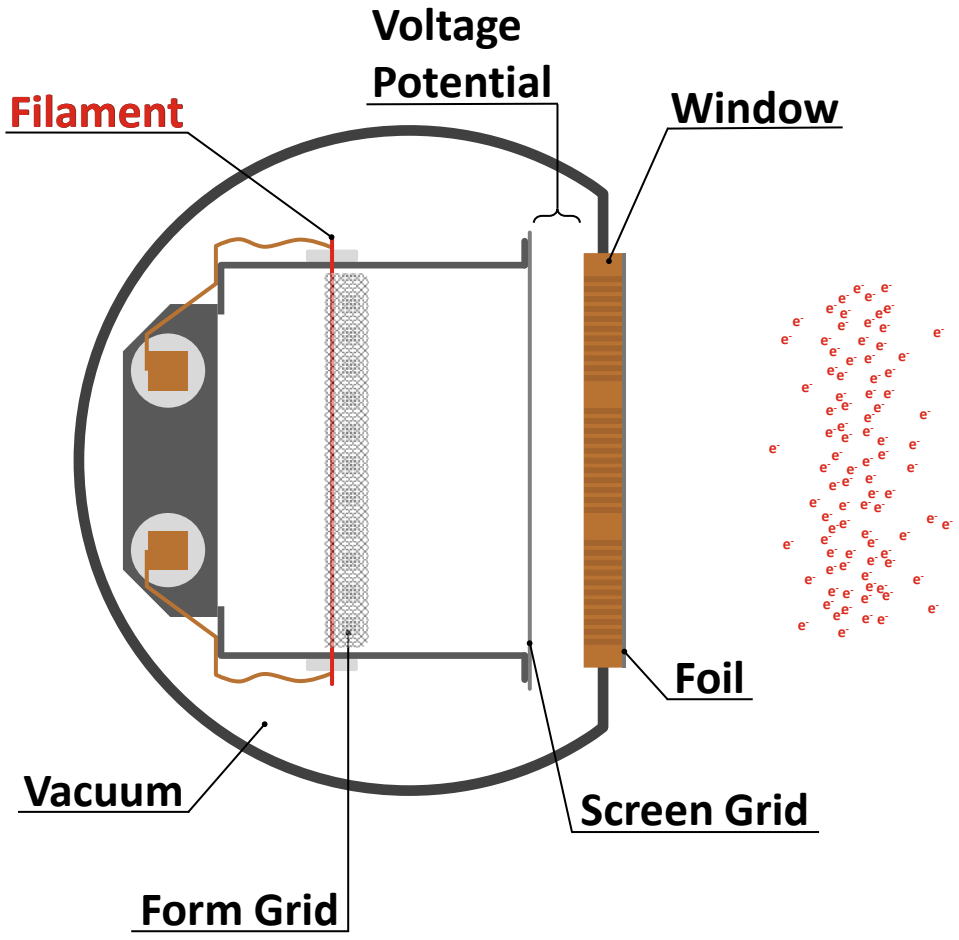
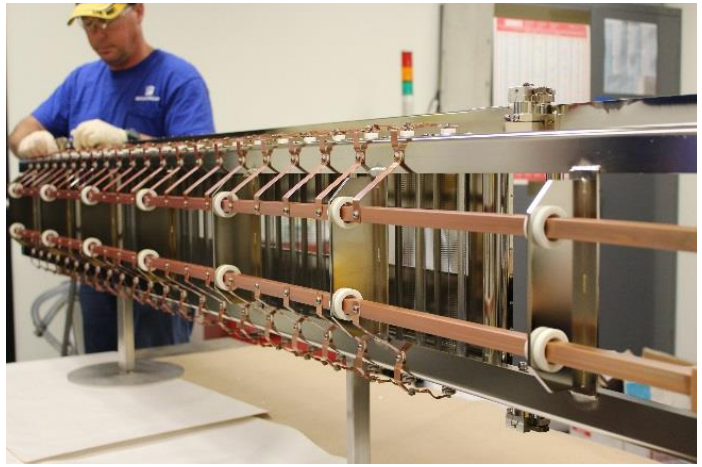
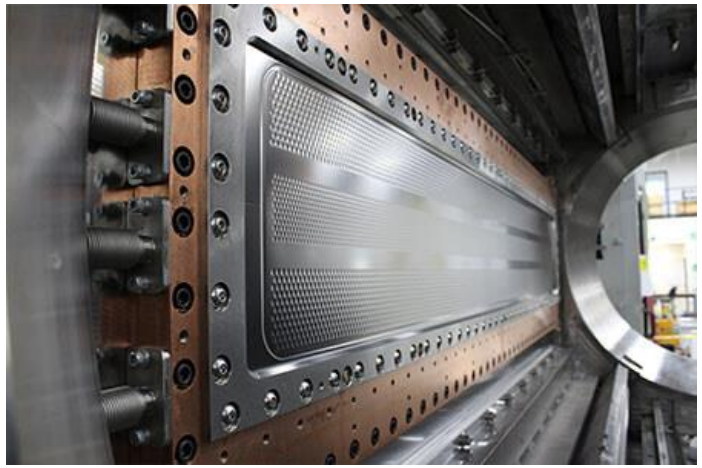
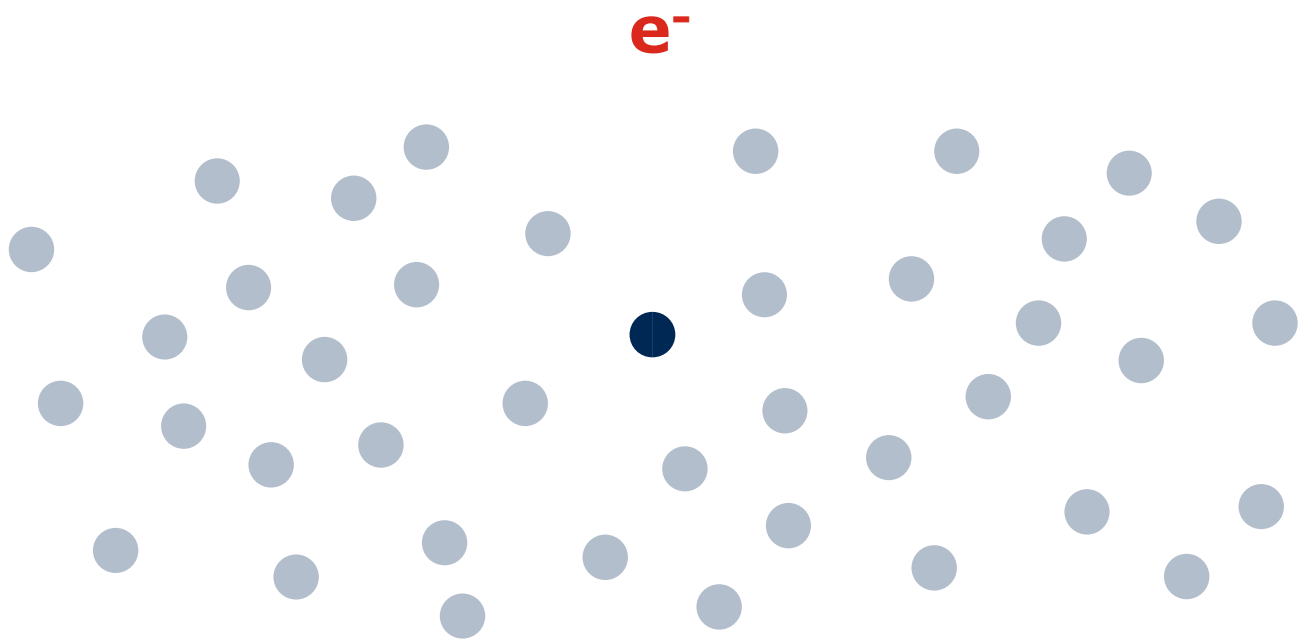






Ebeam uses accelerated electrons to break chemical bonds and initiate chemical reactions.

Ionization: $M \xrightarrow{e^-} 2R^{\cdot}$



Weiss, D., Dunn, D., Richter, K. B., and Adler, R. (2005) Pulsed Electron Beam Polymerization 1–11.

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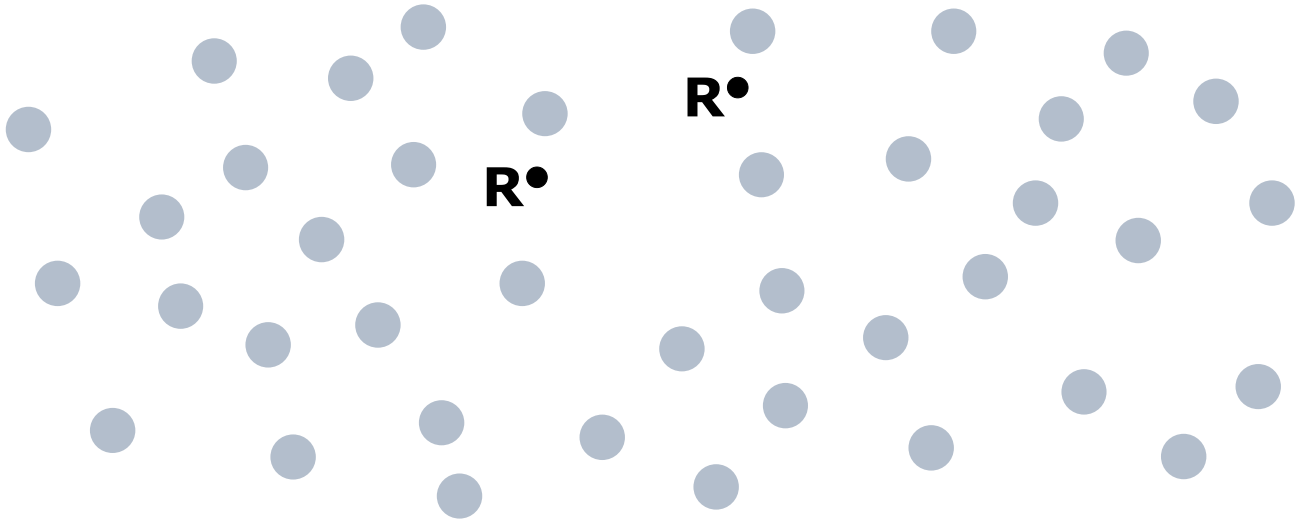
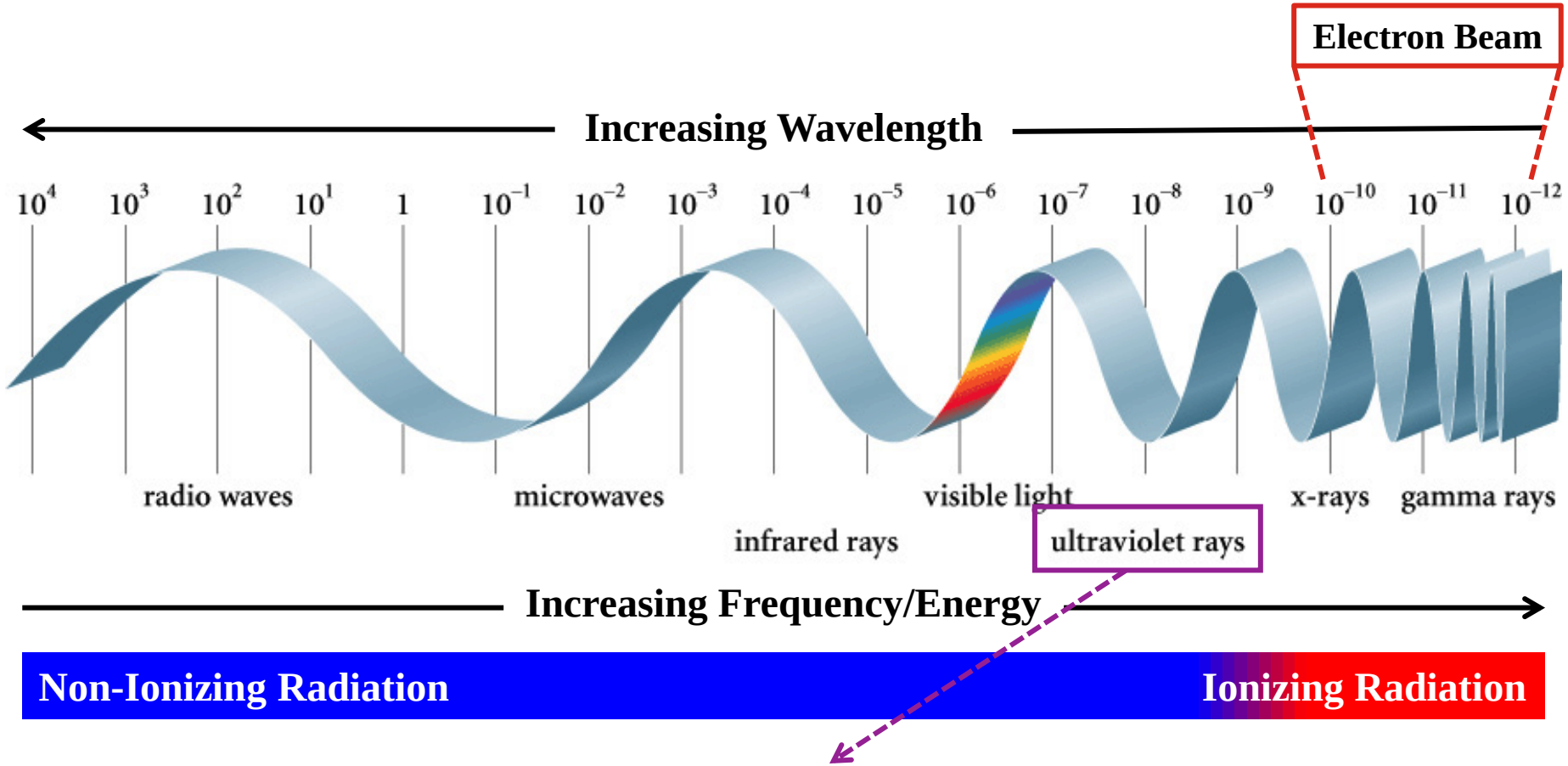


Weiss, D., Dunn, D., Richter, K. B., and Adler, R. (2005) Pulsed Electron Beam Polymerization 1–11.

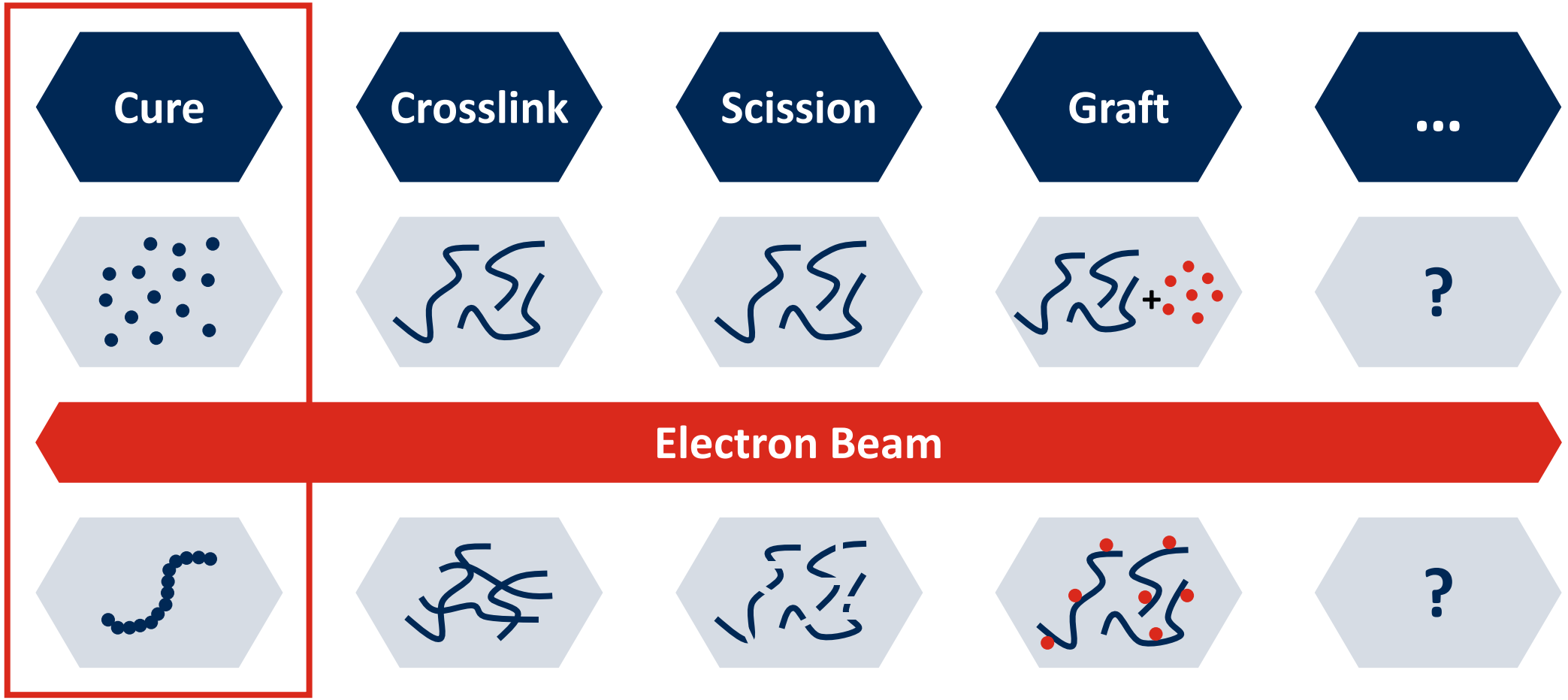
Unlike ebeam, UV is largely non-ionizing radiation and requires a photoinitiator to initiate cure.



$$Photoinitiator \xrightarrow{h\nu} 2R^{\cdot}$$

Adapted from the American Heritage Student Science Dictionary

Ebeam uses accelerated electrons to break chemical bonds and initiate chemical reactions.



The effects of ebeam can be applied to numerous applications.

Flexible Food Packaging

Interior/Exterior Architectural Products

Paperboard Packaging

Pressure-sensitive Adhesives

Tires

Coil Coating

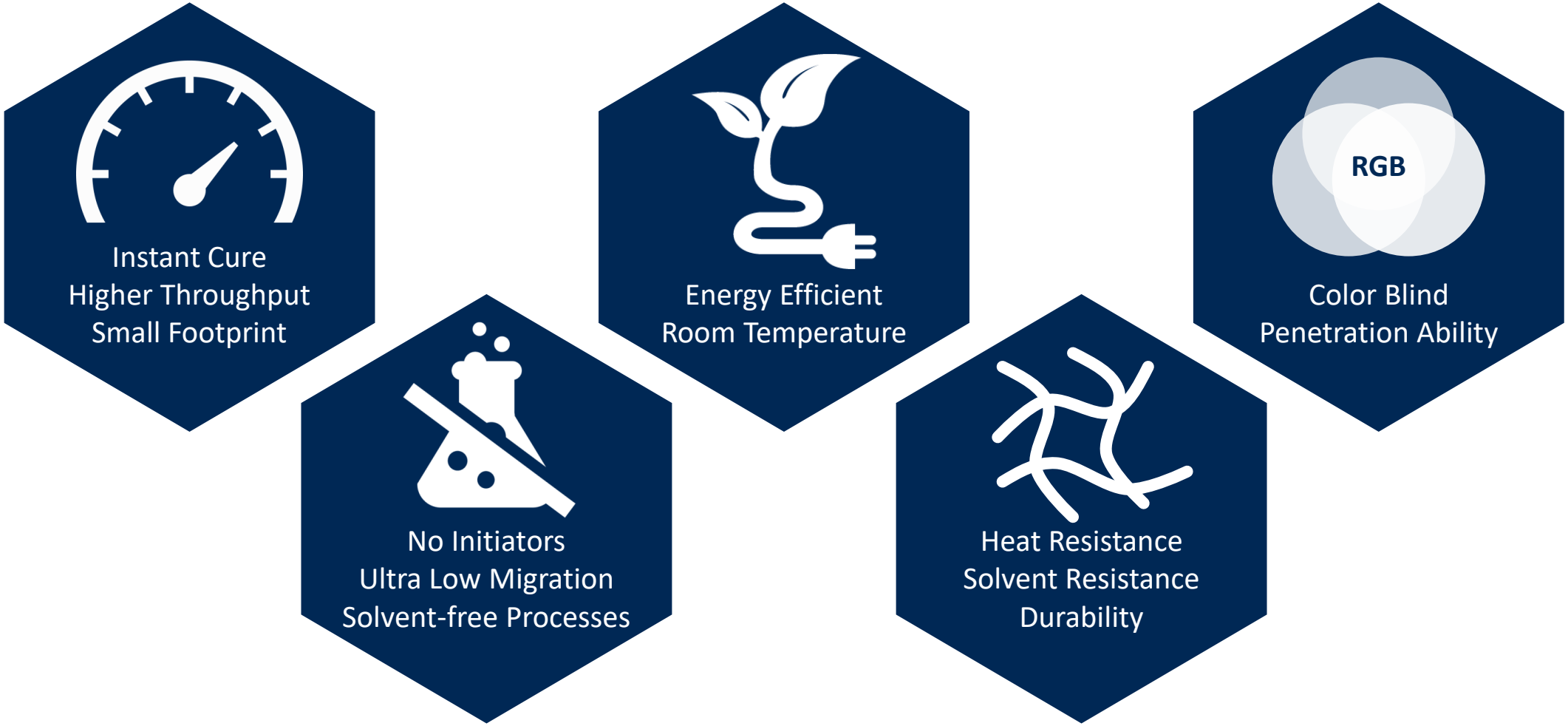
Sterilization and Disinfestation

Heat Shrinkable Films and Sleeves

In an individual application, ebeam can be used to achieve numerous effects.

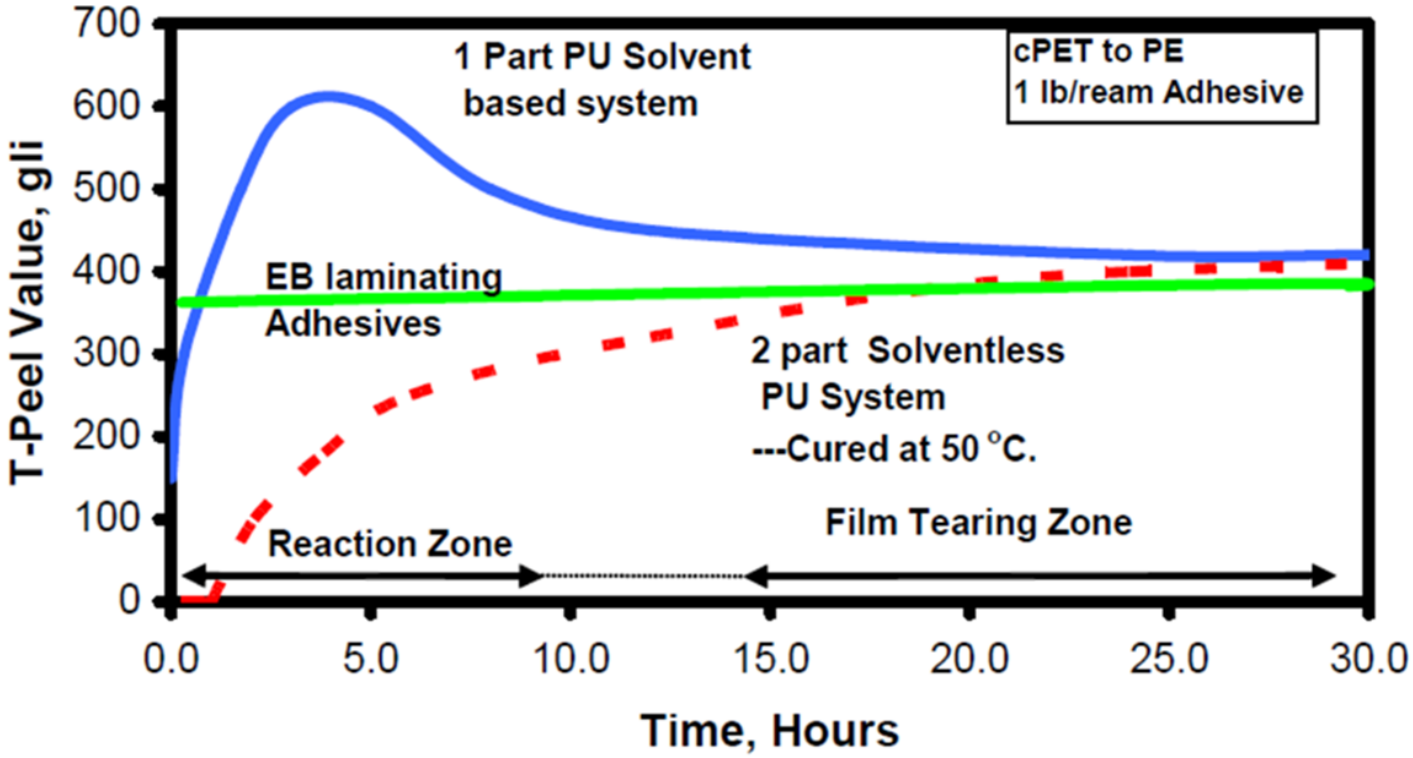
- OPVs
- Inks
- Film-property Enhancement
- Specialty Coatings
- Lamination
- Sterilization
- Adhesives
- Cold Foil Transfer

Ebeam technology has many benefits compared with other methods.



Ebeam lamination is fast, environmentally friendly, and useable in flexible food packaging.

- 100% ‘solids’ adhesive *aka* solvent-free
  - Reduced regulatory burden
  - Shelf-stable for at least 6 months
  - Easy clean-up
- Immediate bond strength
  - Improves turn-around time
  - Reduces waste



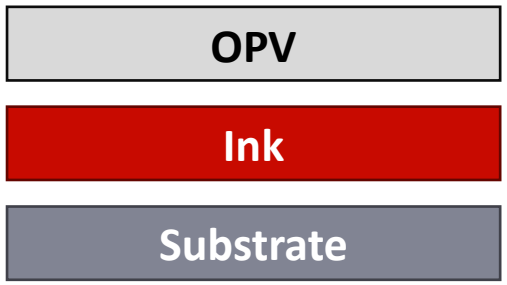
“Laminating Adhesives for Food Flexible Packaging” Lin, A., Meloon, D. RadTech Europe 2005

Ebeam lamination is fast, environmentally friendly, and useable in flexible food packaging.

- 100% ‘solids’ adhesive *aka* solvent-free
  - Reduced regulatory burden
  - Shelf-stable for at least 6 months
  - Easy clean-up
- Immediate bond strength
  - Improves turn-around time
  - Reduces waste
- Compatible with a variety of printing processes and common converting substrates, including metallized substrates
- Lower operating costs and higher line speeds (>2x) compared to thermal lamination
- One EB line can run both lamination and OPV

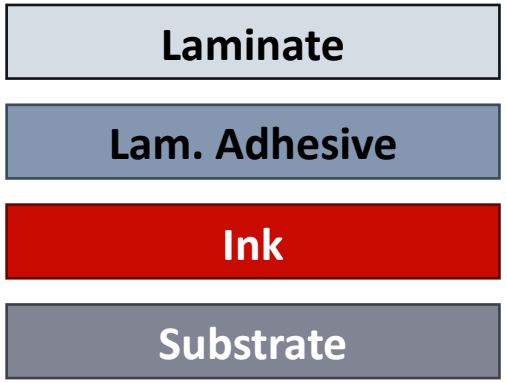
An OPV is a clear, protective EB-curable coating that is a sustainable alternative to lamination.

Overprint Varnish (OPV)



- Reduces material per package
- Compatible with one material and compostable packaging
- Available in gloss, matte, and soft touch finishes

Lamination



- More durable than OPV
- Compatible with one material and compostable packaging
- Available in gloss, matte, and soft touch finishes

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Overprint Varnish (OPV)

compostable packaging

- Available in gloss, matte, and soft touch finishes

Lamination

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PCT offers four different families of low-energy electron beams to accommodate customers' needs.

	INVICTUS	OMNIA	CORE	DYNAMIC
				
Energy	80 – 300 kV	80 – 150 kV	80 – 100 kV	80 – 200 kV
Width	1140 – 2290 mm	915 – 2743 mm	760 mm	200 or 400 mm
Speed	400 mpm	400 mpm	180 mpm	100 mpm

With ebeam…

- Scalable design for wide webs
- Uniform dose
- Compatibility with multiple substrates
  - Plastic film
  - Paper
  - Paperboard
  - Metal foil

What benefits does PCT's patented, integrated shield roll provide users?

- Web control, stability, and access
- Access to the foil/window for maintenance
- Reduced nitrogen consumption
- Heat reduction for temperature sensitive substrates

Ebeam produces x-ray radiation; how is it safe?

S elf-shielded: **certified** not to exceed 0.1 mrem at 10 cm (4 in) from any surface.

A utomatic safety interlocks on every beam.

F ree of a radioactive source; no radiation is present when the beam is off.

E lectrons **don't** make material radioactive.

Ebeam produces x-ray radiation; how is it safe?

Self-shielded: **certified** not to exceed 0.1 mrem at 10 cm (4 in) from any surface.

vs.

Average Annual Dose from Common Sources (mrem)

Domestic plane travel (1 trip, 5 hrs)

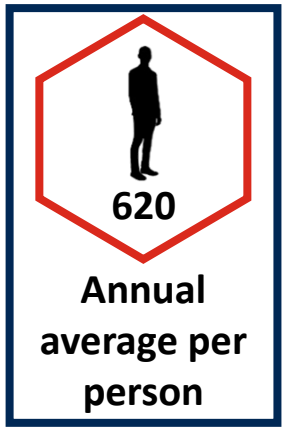
Smoking 1 pack a day

Food and water

Radon in the average U.S. home

Cosmic radiation in Denver, CO

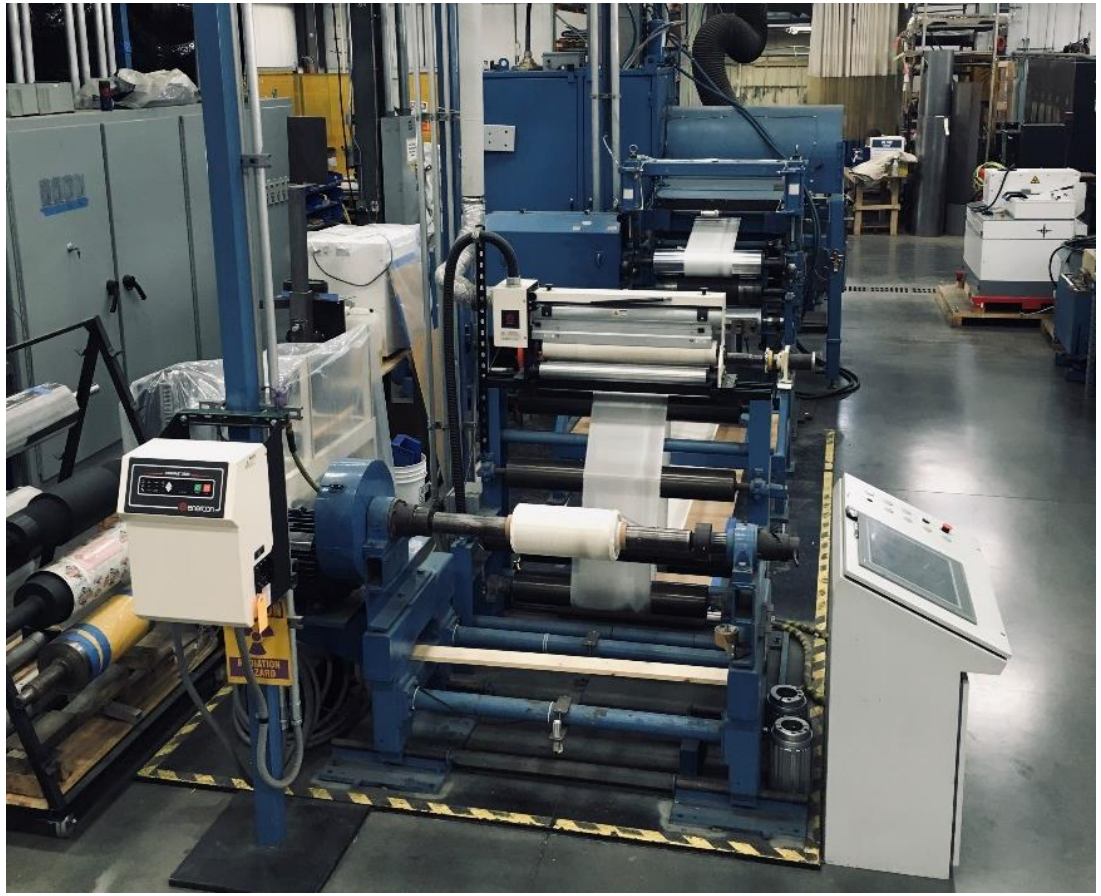
Whole body CT (1 scan)



United States Nuclear Regulatory Commission, National Council on Radiation Protection and Measurements, report No. 160, International Commission on Radiological Protection, publication 103

Our pilot line allows customers the ability to realize the advantages of ebeam in their process through testing.

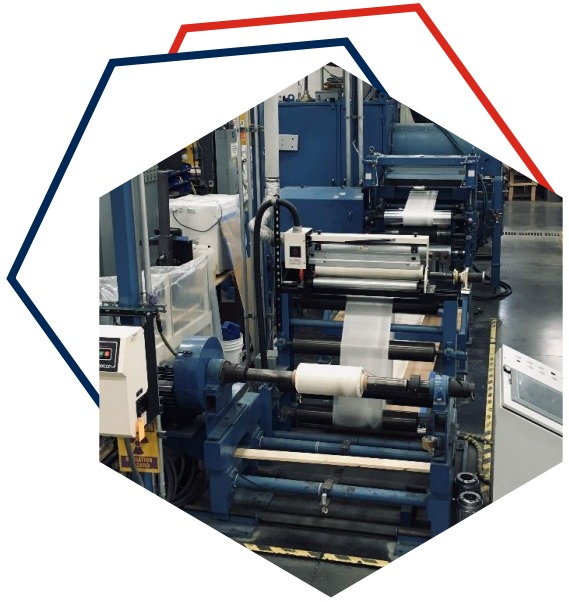
- Proof-of-concept to toll work
- Adaptable to custom configurations
- Indirect gravure coater with corona treater
- 26 inches (660 mm) wide, voltages up to 300 kV
- Optional fiberglass web for sheet samples



Summary

Ebeam technology produces sustainable, high performance products without the use of solvents.

Ebeam designs are customizable to a variety of substrates, widths, and product types to suit customer needs.



PCT can assist with application development.

Questions?

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