Damage to Common Healthcare Polymer Surfaces from UV-C Exposure

- The BIFMA standard expects 7 years of weekly exposure to UV-C and determines the exposure based on: :
  - (500 µW/cm2)/sec X 60 sec/min X 60 min/hr X 16 hr/test period X 1x10-6 J/µW = **28.8 J/cm2**
- Ten plastics were exposed to 6 hrs 24 min of UV-C light consistent with BIFMA standard.
  - Polypropylene (PP)
  - Ultra High Molecular Weight Polyethylene (UHMW PE)
  - Polytetrafluoroethylene (PFTE or Teflon)
  - Clear polymethyl methacrylate (PMMA or clear acrylic)
  - White polymethyl methacrylate (PMMA or white acrylic)
  - Polyoxymethylene (Delrin)
  - Polyester (poly[ethylene terephthalate] or PET)
  - Polycarbonate
  - Nylon
  - Acrylonitrile butadiene styrene (ABS)
- These materials were characterized by:
  - Visual appearance using confocal laser scanning microscopy (CLSM)
  - Chemical composition change using Fourier Transform Infrared Spectroscopy (FTIR)
  - Surface energy change using water contact angle via goniometer
  - Surface roughness/profilometry change using CLSM
  - Material hardness change using nanoindentation
  - Color change (color shift and whiteness change) via spectrophotometer

Summary of Testing Results

Sample	Overall Damage	Microscopy	Roughness	L*A*B Color	Whiteness	Contact Angle	Hardness
Polypropylene (PP)	Minor	Minor	Minor	Minor	Minor	Minor	Moderate
Ultra High Molecular Weight Polyethylene	Minor	Minor	High	Minor	Minor	Minor	Minor
Polytetra fluoroethylene (Teflon PFTE)	Moderate	Moderate	Moderate	Minor	Minor	Moderate	Moderate
Clear Acrylic (PMMA/Polymethyl methacrylate)	Moderate	Moderate	Minor	Minor	Minor	High	Moderate
Polyoxymethylene (Delrin)	Moderate	High	Moderate	Moderate	Moderate	Minor	Moderate
Polyester (poly[ethylene terephthalate]) (PET)	Moderate	Minor	Moderate	Moderate	Moderate	High	High
Polycarbonate (PC)	High	High	Moderate	High	High	High	Moderate
Nylon (Polyamide)	High	Minor	High	High	High	High	Minor
Acrylonitrile butadiene styrene (ABS)	High	Moderate	High	High	High	High	High
Cast Acrylic (PMMA/Polymethyl methacrylate)	High	Minor	High	High	High	Moderate	Moderate

- All characterization methods identified one or more specific degradation features, but with different sensitivity and/or applicability.
- All surfaces showed at least some damage from UV-C exposure. Different plastics showed different types of surface damage.
- UV-C exposure to surfaces typical of routine use of portable UV-C units in healthcare can damage plastic surfaces. Some surfaces are at much higher risk of damage.