UV Energy Cure for Polymeric Coatings communicating Pathogen Deterrents

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Hospital Acquired Infections - HAI's, have become health insurer's, hospital's and the US government's *number one health care cost*, with average HAI patient hospital stays of an *additional* 7 to 10 days often in acute or critical care. Recalcitrant pathogens of but not limited to *clostridium difficile infection* - CDI, *methicillin-resistant staphylococcus aureus* - MSRA and *vancomycin-resistant enterococci* - VRE domains which can be found in dental, emergency room, hospital, laboratory, medical, surgical and trauma center environs lead to cross-communication of pathogens leading to increased patient mortalities.

According to the Centers for Disease Control and Prevention or CDC, in 2011, *one in seven persons* admitted to a hospital in the USA acquired an infection simply from being in a pathogen-rich environment of a hospital – regardless of the scope of the hospitalization. In the prior decade, the HAI patient ratio was one in eight. Infections caused by antibiotic resistant bacteria *alone*, killed 23,000 people in 2011, made 2 million persons sick and cost $35 billion in lost productivity due to sick days within the USA. Of these one-in-seven persons acquiring a hospital infection, in 2011 totaled 722,000 persons – 75,000 patients succumbed to HAI's from any one of the five major classes of pathogens. Today this early mortality number likely exceeds 100,000 patient deaths annually – just *within* the USA, much less of world-wide HAI mortality rates.

Presidential Executive Order 13676 of September 18, 2014 – *Combating Antibiotic-Resistant Bacteria*, established a Task Force headed by Secretaries of Defense, Agriculture and HHS with representatives from 10 Federal Agencies.

Of the Presidential Executive Order *Policy* Section – The Federal Government will work domestically and internationally to detect, prevent, and control illness and death related to antibiotic-resistant infections by implementing measure that reduce the emergence and spread of antibiotic–resistant bacteria and help ensure the continued availability of effective therapeutics for the treatment of bacterial infections.

Of the Presidential Executive Order *Oversight and Coordination* Section – Combating antibiotic-resistant bacteria is a national security priority.

Of the Presidential Executive Order *Promoting New and Next Generation Antibiotics and Diagnostics* Section - c. The Public Health Emergency Medical Countermeasures Enterprise in HHS shall, as appropriate, coordinate with Task Force agencies' efforts to promote new and next generation

countermeasures that target antibiotic-resistant bacteria that present a serious or urgent threat to public health.

Use of cationic coating UV Energy Cure formulations containing Pathogen Deterrents upon a broad spectrum of substrate physical surfaces, including but not limited to polymeric film/sheet allows for Pathogen Deterrents to be communicated of efficacy CFU/ml R values of 6+ with efficacy contact times under 30 seconds without limitation of planktonic, mono-layer and biofilm bacteria as well as gram–negative and gram–positive bacteria, as a barrier to pathogen cross-contamination while rendering the pathogens deterred and/or dead.

One novel and new scope remedy for reduction in HAI recalcitrant pathogens is of incorporation of pathogen deterrents *directly* upon 1st and 2nd surfaces of the *billions* of formed polymer film/sheet disposable components, devices and/or medical procedure kit enclosures and/or packages used throughout dental, emergency room, hospital, medical, surgical and/or trauma center environs. Irrespective of EB+ irradiation sterilization and/or high temperature sterilization methods – doctors, patients, staff and/or visitors all have a single common trait – *all* persons touch and/or handle physical objects including but not limited to charts, computer keyboards and/or touch screens, body fluids, blood, door handles, draping, exchange monies, foods, lavs, light switches, mobile devices, patients, sterile environs, telephones and/or wastes thusly cross-communicating pathogens within and throughout pathogen-rich environs.

Polymer *Materials* may be fabricated in 2 or 3-dimensional shapes by one or more of the following scope *Methods and Apparatus*, as in Table 1:

Blow molding	In-mold decoration
Cast	In-mold labeling
Clad	Insert molding
Co-extrusion	Lamination
Extrusion	Over-molding
Foam molding	Rotational molding
Injection molding	Twin-shot molding

Table 1.

Extruded plastics, of *Method* and *Apparatus* where one or a plurality of plastic *Materials* are melted and formed in a continuous profile through various forms of shaping dies. Once cooled below a plastic's glass transition temperature – Tg, outcome yields a continuous 2- or 3-dimensional profile shape, creating entirely new scope of use outcome for plastics.

Plastic's co-extrusion and extrusion various *Methods & Apparatus* are characterized by:

- Blown film – very thin polymer film for packaging or continuous web sheet outcome
- Coating – where a secondary heated resin is applied via pressure rollers onto moving extruded web outcome
- Co-extrusion – where a plurality of extruders feed a single die to create a multiple layer outcome

- Compound extrusion – where a plurality of polymers and/or additives produce a homogenous outcome
- Extrusion coating – where a thin polymer layer is added upon film, foil and/or paper web outcome *
- Film extrusion – where polymer is a continuous 2-dimension extrusion of less than 0.030" (0.76 mm) thickness but greater thickness than that of blown film outcome
- Extrusion lamination – where hot extruded polymer resin acts as the bonding medium to a second web – sans adhesive-use outcome
- Sheet extrusion - where polymer is a continuous 2-dimensional extrusion greater than or equal to 0.030" (0.76 mm) thickness and a curfed outcome
- Tubing extrusion – where *Method* and *Apparatus* allow for a continuous portal in the drawn direction outcome

*- preferred embodiment of the Abstract

Polymer film/sheet substrate *Materials* most commonly available are listed in Table 2:

ABS	PETG *
Acetate	Polycarbonate *
Acrylic/PMMA	Polyester (Co-polyester) *
Blends	Polyvinyl Chloride
Cellulose acetate butyrate	Styrene *
Impact Modified Acrylic * / PMMA*	Vinyl

*- Preferred Scopes of Use

Table 2

Plastic that is cast, co-extruded and/or extruded as polymer film/sheet *Material* may be manufactured by a variety of options for end use desired specifications and/or scope of use intention outcomes, such as:

- Clear
- Laminate
- Opaque
    - Pigmented / colorants
    - Effect pigments
- Translucent
- Transparent

In addition, cast, co-extruded and/or extruded polymer film/sheet chromatic and/or indicia *Methods* may be of:

- Conformal coating *
- Embossing
- Lamination
- Physical Vapor Deposition - PVD

- Plating-on-Plastics - POP
- Printing
- Resin-based

*- preferred embodiment of the Abstract

In addition, cast, co-extruded and/or extruded polymer film/sheet *Methods and Apparatus* for various fabrication final geometries may be of:

- Flat – 2-dimensional
- Bendable – 3-dimensional simple
- Formable – 3-dimensional complex and/or deep draw
- Moldable – 3-dimensional complex

For the scope of polymer film/sheet disposable components, devices and/or medical procedure kit enclosures and/or packages used throughout dental, emergency room, hospital, medical, surgical and/or trauma center environs require 3-dimensional complex and deep draw final geometries – formability, through thermoforming and/or pressure forming.

Sterilization of said formed polymer film/sheet disposable components, devices and/or medical procedure kit enclosures and/or packages is engaged through either Electron Beam or EB+ Energy Cure of beta radiation – β or high temperature pressure autoclave sterilization at temperatures well above 212F (100C) for use in dental, hospital, laboratory, medical and/or pharmaceutical environs.

Depending upon the sterilization method engaged, low temperature or high temperature formable medical grade plastic film/sheet are specified – either clear and/or opaque from the preferred scope of use polymers identified above.

By incorporating pathogen deterrents *directly* upon 1st and 2nd surfaces of the *billions* of formed polymer film/sheet disposable components, devices and/or medical procedure kit enclosures and/or packages used throughout dental, emergency room, hospital, medical, surgical and/or trauma center environs, cross contamination and/or cross communication of pathogens may be reduced to near zero, *without limitation*, in the USA and world-wide.

Of this new and novel scope of remedy by reductions in HAI recalcitrant pathogen cross contamination and/or cross communication and related patient early mortalities, *Materials*, *Methods* and *Apparatus* de rigueur requirements are of, but not limited to:

- Formable polymeric film/sheet able to withstand prolonged temperatures of up to 250F (121C) without deformation
- Formable polymer film/sheet being clear and/or opaque
- Formable polymer film/sheet being of medical grade
- Formable polymer film/sheet suitable for EB+ Beta radiation without deformation
- Polymeric applied coating being formable without limitation
- Polymeric applied coating capable of being thermoformed without limitations

- Polymeric applied coating capable of engaging Pathogen Deterrents without interference
- Polymeric applied coating capable of withstanding thermoforming temperatures exceeding 450F (232C)
- Polymeric applied coating engaging UV Energy Cure cross-linking mechanisms
- Polymeric applied coating engaging UV Energy Cure mechanisms yielding differing surface and internal cross-linking densities
- Polymeric applied coating having low surface RMS
- Polymeric applied coating having functional and/or physical characteristics to survive hostile environments of abrasion, chemical, mar and/or scratch resistance.
- Polymeric applied coating having varying pathogen deterrent concentrations per bcm

In conclusion, the above combined *Materials*, *Methods* and *Apparatus* de rigueur requirements may only be fulfilled through use of UV Energy Cure cationic coating polymerization chemistry, to engage pathogen deterrents to cease cross contamination and/or cross communication of recalcitrant pathogens with efficacy CFU/ml R values above 6 with contact times of less than 30 seconds to render the pathogens deterred and/or dead without limitation.