

# (12) Indian Patent Application

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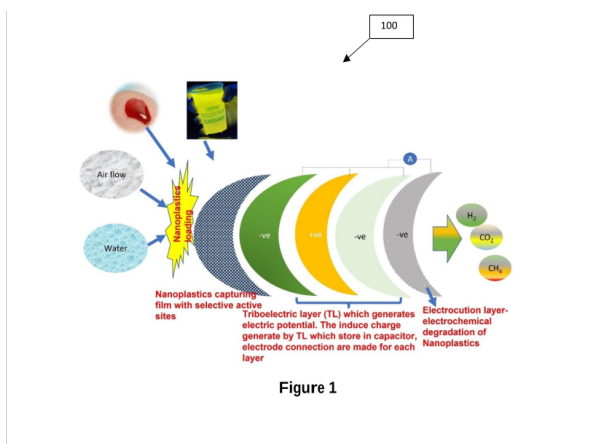
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(54) Title: PROCESS AND SYSTEM FOR PLASTIC DEGRADATION

(57) Abstract: The present disclosure generally relates to the field of chemical sciences and electrostatic system (100) and process. The disclosure further relates to a process for degrading plastic, by-products of plastic and reactive oxygen species (ROS) in a source by subjecting them to electrocution, which results in degradation of plastic, by-products of plastic and ROS into degraded end products. The disclosure furthermore relates to a system for degrading plastics, by-products of plastic and ROS comprising plastic capturing film, voltage multiplier (202), self-charging droplet capacitor (203) and an electrocution layer. The said system (100) is used for quantifying and degrading the plastic in a given source.



# **FORM 2**

THE PATENTS ACT 1970  
(39 OF 1970)  
&  
The Patent Rules, 2003

## **Complete Specification** (See Section 10 and Rule 13)

### **1. TITLE OF THE INVENTION**

**PROCESS AND SYSTEM FOR PLASTIC DEGRADATION**

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### **3. PREAMBLE TO THE DESCRIPTION**

#### **COMPLETE**

The following specification describes the invention and the manner in which it is to be performed

## **DESCRIPTION**

### **TECHNICAL FIELD**

The present disclosure generally relates to the field of chemical sciences and electrostatic device and process. The disclosure further relates to a process for degrading plastic, by-products of plastic and reactive oxygen species (ROS) in a source by subjecting them to electrocution, which results in degradation of plastic, by-products of plastic and ROS into degraded end products. The disclosure furthermore relates to a system for degrading plastics, by-products of plastic and ROS comprising plastic capturing film, voltage multiplier, self-charging droplet capacitor and an electrocution layer. The said system is used for quantifying and degrading the plastic in a given source.

### **BACKGROUND**

Plastics such as particularly, nanoplastics and microplastics have emerged as a pressing environmental issue due to their ability to easily penetrate biological tissues and potentially cause toxic effects. However, quantifying these plastics poses a significant challenge due to their small size. Although FT-IR and Raman spectroscopy methods are commonly employed to analyze microplastics measuring 5 mm or less, particles smaller than 1  $\mu\text{m}$  present difficulties for these techniques. Additionally, thermo-analysis of nanoplastics does not provide size information. The degradation of nanoplastics is critically important because they are persistent and can accumulate in the environment, potentially causing harm to ecosystems and human health. Nanoplastics are difficult to remove from the environment due to their small size and can be ingested by a variety of organisms, leading to potential toxicity and bioaccumulation. Therefore, effective methods for degrading and removing nanoplastics are essential for mitigating their impact on the environment and protecting human health. Thus, a need exists to measure and develop an enhanced process for degrading plastic that is strong, safe, and suitable for industrial-scale settings.

### **SUMMARY OF THE DISCLOSURE**

The present invention provides a process for degrading plastic, by-products of plastic and reactive oxygen species (ROS) in a source and converting them into degraded end products, wherein the said process comprises steps of:

a) capturing/feeding/adsorbing plastic, by products of plastic and Reactive Oxygen Species (ROS) from a natural source or an anthropogenic source.

5

b) quantifying/measuring the plastic, by products of plastic and reactive oxygen species (ROS) obtained from step (a); and

c) degrading the quantified/measured plastic, by products of plastic and reactive oxygen species (ROS) obtained from step (b) by electrocution to convert them into degraded end products; and

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a system for degrading plastics, comprising:

a. a plastic capturing film with selective active sites coated on a triboelectric layer, wherein the triboelectric layer is capable of generating an electrical charge by converting mechanical energy into electrical energy;

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b. a voltage multiplier that is capable of increasing/amplifying the electrical charge generated by the triboelectric layer;

c. a self-charging droplet capacitor that is capable of storing the electrical energy received from voltage multiplier, storing the electric energy and releasing electrical energy; and

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d. an electrocution layer that is capable of employing the electrical energy stored in the self-charging droplet capacitor to degrade the captured plastics.

### **BRIEF DESCRIPTION OF FIGURES**

In order that the disclosure may be readily understood and put into practical effect, reference will now be made to exemplary embodiments as illustrated with reference to the accompanying figures. The figures together with a detailed description below form a part of the specification, and serve to further illustrate the embodiments and explain various principles and advantages, in accordance with the present disclosure wherein:

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**Figure 1** depicts a schematic representation of the proposed triboelectric multilayers comprising a self-powered smart membrane; and

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**Figure 2** depicts block diagram of self-powered smart membrane.

## **DETAILED DESCRIPTION OF THE DISCLOSURE**

The foregoing has broadly outlined the features and technical advantages of the present disclosure in order that the detailed description of the disclosure that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter which form the subject of the description of the disclosure. It should also be realized by those skilled in the art that such equivalent products and methods do not depart from the scope of the disclosure. The novel features which are believed to be characteristic of the disclosure, as to a method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that the figure provided here is for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure. Further, for the purposes of the following detailed description, it is to be understood that the invention may assume various alternative variations and step sequences, except where expressly specified to the contrary.

15

Thus, before describing the present invention in detail, it is to be understood that this invention is not limited to particularly exemplified products and process parameters or methods that may, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments of the invention only and is not intended to limit the scope of the invention in any manner.

20

While the disclosure is susceptible to various modifications and alternative forms, specific embodiment thereof has been shown by way of example(s) and will be described in detail below. It should be understood, however, that it is not intended to limit the disclosure to particular forms disclosed, but on the contrary, the disclosure is to cover all modifications, equivalents, and alternatives, falling within the spirit and the scope of the disclosure. Thus, the use of examples anywhere in this specification including examples of any terms discussed herein is illustrative only, and in no way limits the scope and meaning of the invention or of any exemplified term. Likewise, the invention is not limited to various embodiments given in this specification.

30

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention pertains. In case of conflict, the present document, including definitions will control.

It must be noted that, as used in this specification and the appended claims, the singular forms "a," "an" and "the" include plural referents unless the content clearly dictates otherwise. Thus, for example, reference to a "solvent" may include two or more such solvents.

5 The terms "preferred" and "preferable" refer to embodiments of the invention that may afford certain benefits, under certain circumstances. However, other embodiments may also be preferred, under the same or other circumstances. Furthermore, the recitation of one or more preferred embodiments does not imply that other embodiments are not useful and is not intended to exclude other embodiments from the scope of the invention.

10

As used herein, the terms "comprising", "including", "containing", "involving," and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Further, the terms "comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a method that comprises a list of acts does not include only those  
15 acts but may include other acts not expressly listed or inherent to such method. In other words, one or more acts in a method preceded by "comprises... a" does not, without more constraints, preclude the existence of other acts or additional acts.

In general, the terms electrochemical cell, device, converter, system (100), and/or similar words  
20 used herein interchangeably refer to the equipment/apparatus useful for converting carbon dioxide into methanol.

With respect to the use of substantially any plural and/or singular terms herein, those having  
25 skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. Various singular/plural permutations may be expressly set forth herein for sake of clarity.

Any discussion of documents, methods, acts, materials, devices, articles, and the like that has  
30 been included in this specification is solely for the purpose of providing a context for the disclosure. It is not to be taken as an admission that any or all of these matters form a part of the prior art base or were common general knowledge in the field relevant to the disclosure as it existed anywhere before the priority date of this application.

A detailed description for the purpose of illustrating representative embodiments of the present invention is given below, but these embodiments should not be construed as limiting the present invention.

5 Embodiments of the present invention relate to the simple, efficient, and economical conversion of carbon dioxide to reduced organic products, such as methanol, formic acid and formaldehyde.

The present disclosure relates to a process for process for degrading plastic, by-products of plastic and reactive oxygen species (ROS) in a source and converting them into degraded end products, wherein the said process comprises steps of:

- a) capturing/feeding/adsorbing plastic, by products of plastic and Reactive Oxygen Species (ROS) from a natural source or an anthropogenic source.
  - 15 b) quantifying/measuring the plastic, by products of plastic and reactive oxygen species (ROS) obtained from step (a); and
  - c) degrading the quantified/measured plastic, by products of plastic and reactive oxygen species (ROS) obtained from step (b) by electrocution to convert them into degraded end products.
- 20

In an embodiment of the present disclosure, the plastic is charged/uncharged nano plastic or charged/uncharged microplastic.

25 In another embodiment of the present disclosure, the charged plastic is selected from a group comprising Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), Polyethylene Terephthalate (PET), Polyvinyl Chloride (PVC), Polymethyl methacrylate (PMMA), and Polyamide 6 (PA 6); positively charges plastic is polyurethane (PU), Acrylonitrile Butadiene Styrene (ABS), Polycarbonate, uncharged plastic is polytetrafluoroethylene, negatively charged plastic Polyvinylidene Fluoride (PVDF) and Polyethylene Naphthalate (PEN).

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In an embodiment of the present disclosure, the capturing/feeding/adsorbing plastic is carried out by nanoplastic capturing film with selective active sites.

In another embodiment of the present disclosure, the active sites are electrically active sites.

In yet another embodiment of the present disclosure, the active sites are active adsorption sites.

5

In still another embodiment of the present disclosure, the active sites of nanoplastic film/membrane filters are composed of polylactic acid and polyitaconic doped with manganese oxide dots and cellulosic fibers, wherein cellulosic fibers and Manganese oxide facilitate the selective adsorption of nanoplastics.

10 Filters were developed by incorporating polyiconic acid into the  $\text{CHCl}_3/\text{DMF}$  (9:1) solvent mixture at 10 wt.% together with 90 wt.% of polylactic acid. During the electrospinning process, the aforementioned solution was ejected from the tip of a syringe with a voltage of 20 kV at a feeding rate of 2.0 mL/h. The distance between the capillary and collector was 120 cm. The resulting precursor fibres were collected to form nonwoven on a rotating metal drum, with  
15 a speed of 220 rpm.

In an embodiment of the present disclosure, the membrane filters are multilayered.

A corona charging system (100) is used to create charges on TL layer. The corona charging system (100) is composed of a high voltage source and a corona needle. The sampled is charged  
20 by grounding one side of the sample and by placing the sample below the needle tip, for example 5 cm below the needle tip. In an exemplary embodiment, a voltage as high as  $-15$  kV or 15 kV is applied to the corona needle for 3 minutes. The values provided are only exemplary and the invention is not limited therein. A person skilled will appreciate that charging the sample by any means is covered within the scope of the invention.

25

The corono charged layers (for example three layers) are cut to specific dimensions such as size of  $2 \times 4 \text{ cm}^2$ , and are hot pressed at temperature and pressure such as  $130 \text{ }^\circ\text{C}$  and  $200 \text{ kg/cm}^2$ . Two layers are then placed on either side of a cellulose fiber layer to serve as a triboelectric structures. Further, pores are punched in the cellulose fiber layer using a physical process.  
30 Subsequently, an imprinting process is used to transfer microscale patterns obtained from for example sandpaper to the surfaces of the cellulose fiber layer. Finally, the three fiber layers are assembled step-by-step.

A self-powered droplet capacitor is fabricated on a substrate (fullerene (0.1 mM) doped IN-Ti-Sn-Si nanofibers (1:1:3 molar ratio) that is modified with 250-nm-thick tantalum hafnium carbide and showed good conductivity. This substrate functions as the fixed electrode for the droplet capacitor. Tantalum hafnium carbide coating provides necessary insulation to avoid the droplet capacitor to be shorted due to possible pinholes in the hydrophobic coatings. The thicknesses of poly-Tetrafluoroethylene and poly-Perfluoroalkoxy alkane coatings may be approximately 1.2  $\mu\text{m}$  and 22.5  $\mu\text{m}$ , respectively. A water drop of a volume of 500  $\mu\text{L}$  may be used as the movable electrode. Acrylic blocks are bonded to the surface with adhesives to create a confined space within which the water drop can move freely. The corresponding capacitance is then measured directly to be for example  $C=2.5$  nF when the water drop is on poly - Tetrafluoroethylene and  $C= 1.1$  nF when it was on poly-Perfluoroalkoxy alkane.

Nanoplastics in the environment can be charged positively, negatively, or neutrally. Keeping this in mind, the multiple triboelectric layers (TL) for the nanogenerator were chosen to be fabricated. Here, the TL layer was integrated with a droplet flexible capacitor via a voltage multiplier (202), which provided electricity to electrocution layer (EL) (as shown in Fig. 2). The self-powered induced potential allows the conducting mesh framing of these layers to transfer charges between them. The layer is capable of acquiring the static charges so that any nanoplastics having a surface charge can easily be inactivated and degraded. The electrically activated EL can adhere electrically to the charged/uncharged nanoplastics coming from the vicinity of the smart membrane (Figs. 1 and 2).

The triboelectric nanogenerator (TENG) (201) harvests mechanical vibrations and motion. During frictional motion/sliding, triboelectric charges are generated on the surfaces between the two dielectrics, causing a potential difference between the two electrodes. The self-power generation is based on surface charge engineering. In the present invention., the smart membrane is integrated with a triboelectric generator along with electrocution layer that is flexible metallic mesh. Thus, increasing the triboelectric charges is one of the major factors in improving the resulting energy density between the electrocution layer.

The TL layer comprise one triboelectric positive layer (polylactic acid) and two triboelectric negative layers of (polyitaconic acid) comprising a triboelectric nanogenerator. The two ends of three layers may have two spacers. These spacers are connected to Voltage Tripler Circuit (VTU), following the droplet capacitor and EL at the end. Depending on the application, this

arrangement can change. At any motion/mechanical state of the nanogenerator, negative charges in the layer will generate corresponding positive induced charges in the top and bottom net electrodes, respectively, assuming that the charges are distributed uniformly as well as surplus of charges. In the initial state, the electric potential distribution between the layers is in an equilibrium state, and no charges will transfer. During the mechanical motion/vibration/disturbance process (for example, airflow to the layers), airflow can penetrate the pores of the net electrodes, resulting in the random and fast swing of the layers between both electrodes.

When the layers get closer to the bottom electrode, more positive charges ( $\sigma_1$ ) will be induced in the bottom electrode, simultaneously reducing the positive charges in the top electrode. If the layers get closer to the top electrode, the variation tendency of charges will be opposite. In general, the random swing of the three layers by mechanical motion continually breaks the electric potential equilibrium between the two electrodes, and alternating electricity is generated. Alternating electricity generated by the triboelectric nanogenerator was rectified and stored in a droplet capacitor.

Each layer of the TENG (201) was modified by imprinted polymer coatings. These imprinted coatings are developed on the surface by electrochemical methods (cyclic voltammetry) to capture ROS and nanoplastics.

Keeping all these in mind, four combinations of three layers have been chosen, each with a pair of positive and negative triboelectric series materials connected to the capacitor via the VTU tabulated in Table 1 (section 7).

The electrospun membrane acts as a multilayered (Polylactic acid and polyitaconic doped with manganese oxide dots and cellulosic fibers) triboelectric nanogenerator filter, and the outer one as an electrocution layer. This smart membrane contains surplus charges and active adsorption sites, which selectively extract all the nanoplastics (neutral, positively, and negatively) as well as reactive oxygen species (ROS). Finally, the EL degrades the nanoplastics into carbon sources and water. Here, selective binding sites on the membrane facilitate the nanoplastics binding, and manganese oxide acts as a scavenger for ROS. The mechanical force generated via motion (exhaled air, blood flow, stirring in water, walking, etc.). The force exerted on triboelectric filter materials can produce sufficient electric power to activate electrocution and degradation of nanoplastics. In an embodiment of the present disclosure, the plastic, by-

products of plastic and reactive oxygen species (ROS) are measured by colorimetric, fluorescence and change in capacitance/impedance.

5 In an embodiment of the present disclosure, the colorimetric method employs a dye, Nile red, gold nanoparticles.

In another embodiment of the present disclosure, the degraded end products are selected from a group comprising hydrogen gas, carbon dioxide, methane Nitrogen, Sulphur dioxide, ethylene.

10

In an embodiment of the present disclosure, the natural source includes plastic debris that accumulates in the environment, such as on beaches or in oceans and clay minerals can release plastic precursors when exposed to heat or pressure, water, ocean, atmosphere.

15 In another embodiment of the present disclosure, the anthropogenic sources includes plastic waste, industrial processes, textile, tire water or personal care products.

In an embodiment of the present disclosure, the membrane filters are electrically charged.

20 In another embodiment of the present disclosure, the membrane filters are positively charged or negatively charged.

The present invention provides a system (100) for degrading plastics, comprising:

- 25
- a. a plastic capturing film with selective active sites coated on a triboelectric layer, wherein the triboelectric layer is capable of generating an electrical charge by converting mechanical energy into electrical energy;
  - b. a voltage multiplier (202) that is capable of increasing/amplifying the electrical charge generated by the triboelectric layer;

c. a self-charging droplet capacitor (203) that is capable of storing the electrical energy received from voltage multiplier (202), storing the electric energy and releasing electrical energy; and

5 d. an electrocution layer that is capable of employing the electrical energy stored in the self-charging droplet capacitor (203) to degrade the captured plastics.

In an embodiment of the present disclosure, the system (100) further comprises colorimetric device, fluorescence measuring device and change in capacitance/impedance measuring device to measure the change in electric potential of triboelectric layer when the plastic comes in  
10 contact with the triboelectric layer.

In another embodiment of the present disclosure, the plastic capturing film is composed of nanocellulose fibers or silver nanoparticles assembled around SiO<sub>2</sub> nanoparticles.

15 In yet another embodiment of the present disclosure, the triboelectric nanogenerator is composed of one triboelectric positive layer comprising polylactic acid and two triboelectric negative layers comprising polyitaconic acid to form a triboelectric nanogenerator.

In still another embodiment of the present disclosure, the triboelectric electric layer is  
20 electrically charged.

In still another embodiment of the present disclosure, the triboelectric electric layer is positively charged or negatively charged.

25 In still another embodiment of the present disclosure, the droplet capacitor layer is composed of fullerene doped In-Ti-Sn-Si nanofibers that was modified with thick tantalum hafnium carbide.

In still another embodiment of the present disclosure, the electrocution layer is composed of flexible metallic mesh.

5 In still another embodiment of the present disclosure, the electrocution layer is composed of flexible copper mesh.

In an embodiment of the present disclosure, filtering and degradation mechanism can be monitored by colorimetric, fluorescence and change in capacitance/impedance.

10 In another embodiment of the present disclosure, the membrane also facilitates the capturing and monitoring of ROS, by products of nanoplastics.

In yet another embodiment of the present disclosure, the membrane can be used for air filtration, water treatment, urine and human blood analysis.

15

In still another embodiment of the present disclosure, the degradation efficiency was found 90-93.5% in 30 minutes.

20 Filters are capable of filtering the nanoplastics variants with different composition and shapes (PE, PP, PS, PET, PVC, PU (positive charge), PMMA, and PA 6) and quantifying it. The electric output performance was comprehensively investigated and a maximum power density of 16.7 W/m<sup>2</sup> was obtained, which is large enough to power common low-power-consumption electronic devices. The quantification of nanoplastics and ROS was done due to good correlation with mechanical motion (air flow, circular motion, nanoplastics concentration and  
25 electrical signals).

The system (100) described herein possesses significant potential for a wide range of applications. For instance, it can be utilized as a smart mask for filtration, quantification, and fast degradation of nanoplastics in just 30 minutes. Additionally, the system (100) has the  
30 collective potential to capture both nanoplastics and ROS in a single membrane. The design novelty lies in the self-activation of the EL via minor mechanical energy, such as water circulation from the wearer, and it can handle aerosols, droplets, air flow, body movement, and breath. The system (100) can extract and degrade nanoplastics in all types of samples, including urine, blood, inhaled/exhaled air, milk, and water. Furthermore, we can monitor nanoplastics

with the naked eye through the integrated chemiluminescence in the nanoplastics capturing film as well as in TE and EL layers. The system (100) also features droplet capacitors that provide position variance capacitance, comprised of fullerene doped In-Ti-Sn-Si nanofibers electrode and dielectric slippery conductive polymer layer Tetrafluoroethylene and perfluoroalkoxy alkane.

The present disclosure is further defined in the following examples. It should be understood that these examples indicating exemplary embodiments of the present disclosure are given by way of illustration only and should not be construed to limit the scope of the disclosure. From the above discussion and these examples, one skilled in the art can ascertain the essential characteristics of this disclosure, and without departing from the spirit and scope thereof, can make various changes and modifications of the disclosure to adapt it to various uses and conditions.

**EXAMPLES:**

In an embodiment, the system (100) can be realized as a smart membrane comprising only the plastic capturing film with selective active sites coated on the TL, where the TL is capable of generating an electrical charge by converting mechanical energy into electrical energy.

**EXAMPLE 1:**

The system (100) may be implemented on a tea bag. When the tea bag is moved, the motion of the tea bag is harvested by the TENG (201). The plastics (preferably but not limited to, nanoplastics) may contain static charges (positive or negative). The plastics may be attracted by the TL which is charged. The charges on the TL are retained by the TENG (201) which generates electric charges using mechanical motion of the tea bag. Further, the plastics attracted by the TL are then electrocuted by the EL which generates enough electrical charges to degrade the plastics. Hence, the plastics are removed from the tea bag and the surrounding environment.

**EXAMPLE 2:**

The system (100) may be implemented on a container with sample. Nanoplastics on the container may get deposited on the TL. Further, the plastics in the air as well may get deposited on the TL. The movement of the plastic cup may be used to generate electric charges and maintain the charges on the TL. The TENG (201) ensures generating the electric charges and storing the charges in the droplet capacitor. The EL of the system (100) is then used to

electrocute the plastics. The EL makes use of the charges stored in the droplet capacitor to electrocute the plastics. A high voltage of say 15-20kV may be applied to electrocute the plastics. Applying high voltage degrades the plastics and making the plastic cup free from the plastics.

5

In an embodiment, the proposed process and system (100) ensures degradation of plastics without using chemical process which are generally hazardous, while effectively degrading plastics. Also, the proposed system (100) is self-energized, meaning, the electric charges is produced from mechanical motion and external power source may not be required. Hence, the solution is sustainable and effective. Thus, this method is a fast and effective approach for removing, measuring, and/or degrading plastic, plastic by-products, and reactive oxygen species (ROS) from a given source.

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**Optimization results:** The detailed characteristics, e.g. effective TECD (highest triboelectric charge density), Charge affinity and saturation voltage among the four pairs of Triboelectric multilayered (TML) are illustrated in Table 1.

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Pair	TML	TECD (nC/m <sup>2</sup> )		Effective TECD	Effective charge	Voltage Saturation
		(-ve)	(+ve)			
1	PVC (-ve) + Nylon (+ve)	0.0134	4245.1	4245.23	135	11.87
2	PP (-ve) + PU (+ve)	0.1123	3867.32	3868.31	145	10.45
3	PP (-ve) + PU (+ve)	0.023	3871.21	3871.45	165	10.12
4	Latex rubber (-ve) + PU (+ve)	0.034	3765.45	4765.46	125	10.23
5	Polyitaconic acid (-ve) + Poly-lactic acid (+ve)	0.1567	4322.12	4323.34	175	12.12

**Table 1**

**WE CLAIM:**

1. A process for degrading plastic, by-products of plastic and reactive oxygen species (ROS) in a source and converting them into degraded end products, wherein the said process comprises steps of:
  - a) capturing/feeding/adsorbing plastic, by products of plastic and Reactive Oxygen Species (ROS) from a natural source or an anthropogenic source.
  - b) quantifying/measuring the plastic, by products of plastic and reactive oxygen species (ROS) obtained from step (a); and
  - c) degrading the quantified/measured plastic, by products of plastic and reactive oxygen species (ROS) obtained from step (b) by electrocution to convert them into degraded end products.
2. The process as claimed in claim 1, wherein the plastic is charged/uncharged nano plastic or charged/uncharged microplastic, wherein the charged plastic is selected from a group comprising Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), Polyethylene Terephthalate (PET), Polyvinyl Chloride (PVC), Polymethyl methacrylate (PMMA), and Polyamide 6 (PA 6); positively charged plastic is polyurethane (PU), Acrylonitrile Butadiene Styrene (ABS), Polycarbonate, uncharged plastic is polytetrafluoroethylene, negatively charged plastic Polyvinylidene Fluoride (PVDF) and Polyethylene Naphthalate (PEN).
3. The process as claimed in claim 1, wherein the capturing/feeding/adsorbing plastic is carried out by nanoplastic capturing film with selective active sites, wherein active sites are electrically active adsorption sites, wherein the active sites of nanoplastic film/membrane filters are composed of polylactic acid and polyitaconic doped with manganese oxide dots and cellulosic fibers, wherein cellulosic fibers and Manganese oxide facilitate the selective adsorption of nanoplastics, wherein membrane filters are multilayered, wherein the membrane filters are positively charged or negatively charged.
4. The process as claimed in any preceding claims, wherein the plastic, by-products of plastic and reactive oxygen species (ROS) are measured by colorimetric, fluorescence and change

in capacitance/impedance, wherein colorimetric method employs a dye, Nile red, gold nanoparticles.

5. The process as claimed in claim 1, wherein the natural source includes plastic debris that accumulates in the environment, such as on beaches or in oceans and clay minerals can release plastic precursors when exposed to heat or pressure, water, ocean, atmosphere; and wherein the anthropogenic sources includes plastic waste, industrial processes, textile, tire water or personal care products, wherein the degraded end products are selected from a group comprising hydrogen gas, carbon dioxide, methane Nitrogen, Sulphur dioxide, ethylene.
6. A system (100) for degrading plastics, comprising:
  - a. a plastic capturing film with selective active sites coated on a triboelectric layer, wherein the triboelectric layer is capable of generating an electrical charge by converting mechanical energy into electrical energy;
  - b. a voltage multiplier (202) that is capable of increasing/amplifying the electrical charge generated by the triboelectric layer;
  - c. a self-charging droplet capacitor (203) that is capable of storing the electrical energy received from voltage multiplier (202), storing the electric energy and releasing electrical energy; and
  - d. an electrocution layer that is capable of employing the electrical energy stored in the self-charging droplet capacitor to degrade the captured plastics.
7. The system (100) as claimed in claim 6, further comprises colorimetric device, fluorescence measuring device and change in capacitance/impedance measuring device to measure the change in electric potential of triboelectric layer when the plastic comes in contact with the triboelectric layer.
8. The system (100) as claimed in claim 6, wherein the plastic capturing film is composed of nanocellulose fibers or silver nanoparticles assembled around SiO<sub>2</sub> nanoparticles.
9. The system (100) as claimed in claim 6, wherein the triboelectric nanogenerator is composed of one triboelectric positive layer comprising polylactic acid and two

triboelectric negative layers comprising polyitaconic acid to form a triboelectric nanogenerator.

10. The system (1000) as claimed in claim 6, wherein the triboelectric electric layer is positively charged or negatively charged, the droplet capacitor layer is composed of fullerene doped In-Ti-Sn-Si nanofibers that was modified with thick tantalum hafnium carbide, the electrocutation layer is composed of flexible metallic mesh, preferably flexible copper mesh.

Dated this 13<sup>th</sup> day of March 2023

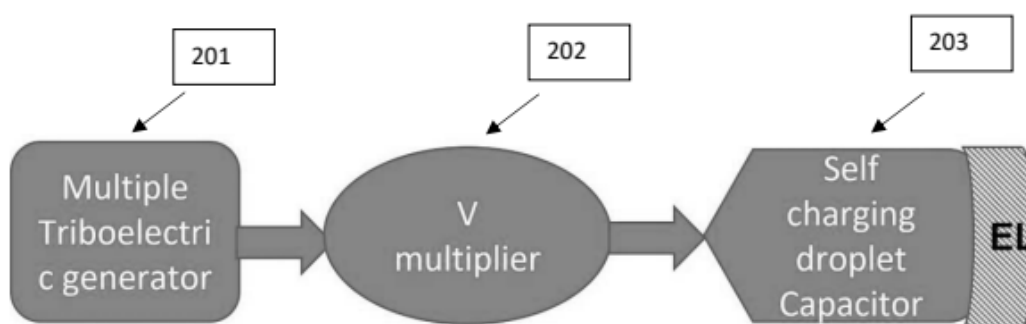
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## ABSTRACT

### PROCESS AND SYSTEM FOR PLASTIC DEGRADATION

The present disclosure generally relates to the field of chemical sciences and electrostatic system (100) and process. The disclosure further relates to a process for degrading plastic, by-products of plastic and reactive oxygen species (ROS) in a source by subjecting them to electrocution, which results in degradation of plastic, by-products of plastic and ROS into degraded end products. The disclosure furthermore relates to a system for degrading plastics, by-products of plastic and ROS comprising plastic capturing film, voltage multiplier (202), self-charging droplet capacitor (203) and an electrocution layer. The said system (100) is used for quantifying and degrading the plastic in a given source.



**Figure 2**

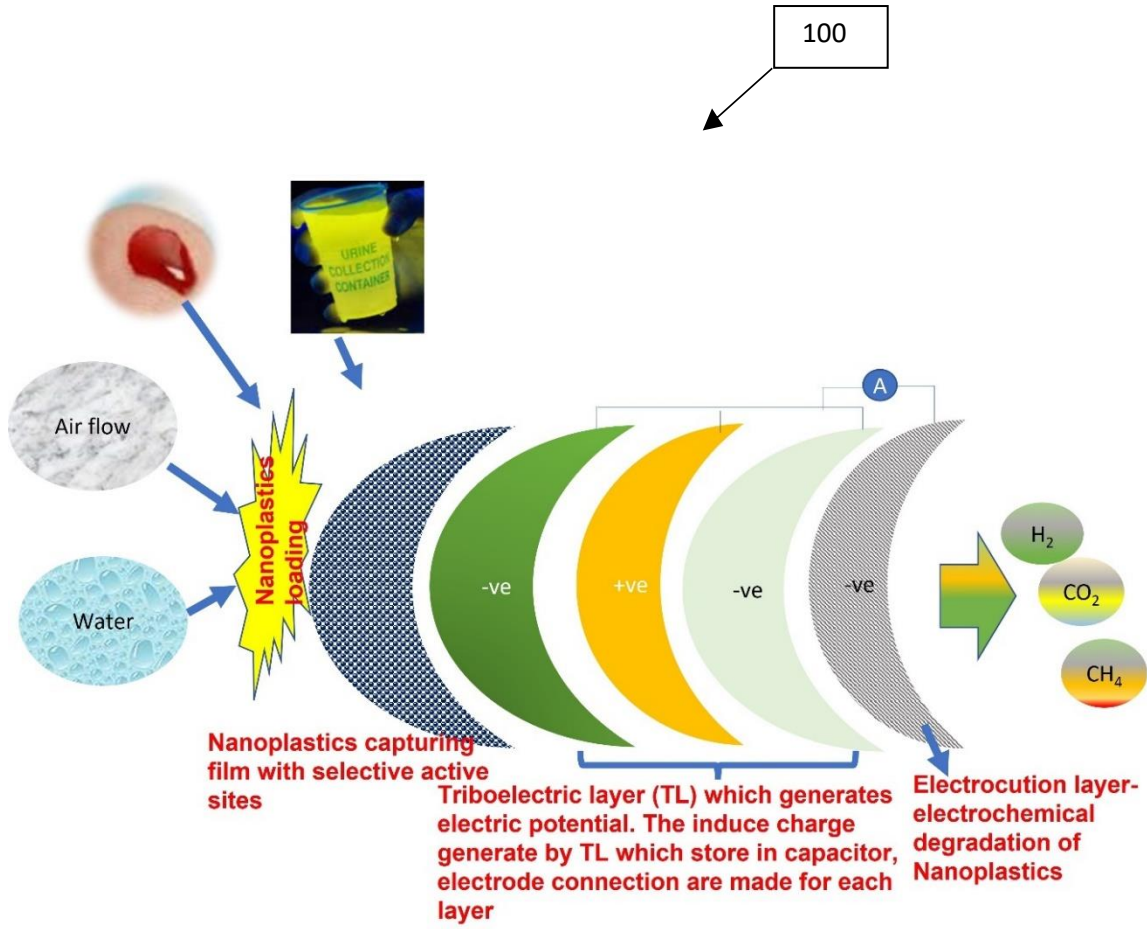
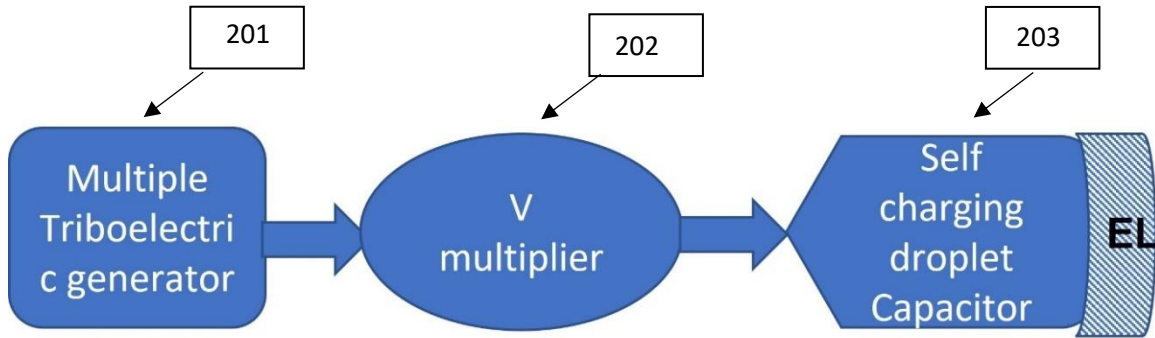


Figure 1

-- Digitally Signed--  
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L&T Technology Services Limited,  
DLF 3rd Block, 2nd Floor,  
Manapakkam, Chennai - 600089.



**Figure 2**

-- Digitally Signed--  
Bhanu Prasad  
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