Supplementary Information (SI) for Journal of Materials Chemistry C.

Table S1. A comparative list of TENGs based on proteins, synthetic materials and other biomaterials in terms of design, area, main output characteristics and stability.

Category	Friction layer 1			Conducting layer	encapsulated layer	Area	TENG output performance					Stability (cycle period)	Reference
	Materials	Surface treatment	Friction layer 2				V_{oc}	I_{sc}	Output power	Transfer charge	Power density		
Protein materials	SF	coating	Mg	Mg	(50-μm-thick) silk pocket	2 cm × 4 cm	1060 V	101 μA	-	-	38.5 mW/m^2	-	19
	skin	-	RG	PC yarns	PVA	1 cm × 2 cm	＞350 mV	-	-	-	-	＞8000	272
	RSFF/PEO	electrospinning	PVDF-HFP	Ag	-	4 cm × 4 cm	120 V	0.33 μA	-	-	40 μW/cm^2	-	163
	RSFF/PEO	electrospinning	PDMS	PANI/CA, Ag	PET	2 cm × 2 cm	225 V	1.5 μA	-	-	3.6 mW/cm^2	1500	234
	PVA-SF	casting	PTFE	Al, Au	acylic	5 cm × 5 cm	280 V	17.3μA	-	32.5 nC	14.4 W/m^2	10000	236
	CN-silk	weaving	F-cotton	Cu	-	3 inch × 3 inch	216.8 V	50.3 μA	-	-	0.345 mW/cm^2	1000	238
	RSFF	casting	PDMS	graphite	-	6 cm × 6 cm	666 V	174.6 μA	-	-	412 μW/cm^2	-	140
	RSFF	electrospinning	PVA/MXene	Al	-	diameter: 6 cm	118.4 V	-	-	-	1087.6 mW/m^2	124000	173
	SF	casting	PTFE	Al	acrylic	2 cm × 2 cm	395 V	-	-	-	22.05 W/m^2	10000	202
	SF	casting	PET	ITO	-	2 cm × 4 cm	268 V	5.78 μA	1.55 mW	92 nC	193.6 μW/cm^2	18000	28

RSFF	electrospinning, electrospray	PET	ITO	-	1.5 cm × 3 cm	276 V	9.2 μA	-	-	317.4 μW/cm^2	75600	137
RSSP/GR/CNT	spin-coating	PET	ITO	PET	6 cm × 8 cm	2600 V	480 μA	-	-	52290 mW/m^2	36000	57
CK	freeze-drying	PTFE	Cu	PLA	2.5 cm × 2.5 cm	324 V	32.2 μA	-	-	14.4 W/m^2	8000	71
feather	plasma treatment	PTFE	Al	acrylic substrate	4 cm × 3.5 cm	247 V	27 μA	2.72 mW	-	1.943 W/m^2	-	67
feather	reactive ion etching	PTFE	Al	acrylic substrate	4 cm × 3.5 cm	449 V	63 μA	-	152 nC	-	-	66
rabbit furs	-	FEP	PCB	acrylic plate	outer radius: 7 cm	1100 V	13 μA	6.89 mW	240 nC	3.275 W/m^3	10000	80
CNF/RF	-	PI	ITO	PET	1 cm × 2 cm	110.0 V	11.3 μA	-	-	3.4 W/m^2	-	75
rabbit furs	-	PTFE	PCB	UV-curable resin	outer diameter: 15 cm	-	74.0 μA	6.2 mW	-	1.75 W/m^3	400000	76
CA	electrospinning	PVDF	carbon NF film	-	5 cm × 5 cm	350 V	1.2 μA	-	-	82.7 mW/m^2	10000	165
CA NFs	electrospinning	B-C-N PVA/PVDF NFs	sprial electrode copper mesh	CA-P-M NFs	1 cm × 1 cm	26 V	0.19 μA	-	-	79.4 mW/m^2	10000	166
fish bladder	deposite	FEP	Cu	-	4 cm × 4 cm	106 V	7.3 μA	0.39 mW	41 nC	200 mW/m^2	850	88

human hair	bar and spin-coating	Kapton	ITO	glass	2 cm × 3 cm	103 V	10.9 μA	-	-	60 mW/m^2	-	239
skin	-	Ecoflex	GelMA/MoS_2	-	3 cm × 3 cm	48.80 V	0.57 μA	-	-	-	1000	216
Rohu fish scale	-	PTFE	Cu, Al	plastic/cardboardsupport sheet	3 cm × 4 cm	180 V	1.7 μA	-	-	-		86
FG	-	PTFE/PDMS	Cu	print paper	5 cm × 5 cm	130 V	0.35 μA	-	-	45.8 μW/cm^2	10 000	120
Cu	-	PDMS	FG-Ag hydrogel	-	5 cm × 5 cm	232 V	1.6 μA	-	-	0.9 mW/m^2	5000	157
gelatin	spin-coating	PI	Cu	support plates	5 cm × 5 cm	400 V	—	6.16 mW	-	-	11 400	97
ESM/SnO	CBD	PTFE	Al	-	3 cm × 6 cm	15.8 V	0.146 μA	1.18 mW	-	-	5400	102
RG (pH-cycle) film	ultrasonic	PDMS	-	-	4 cm^2	170 V	14 μA	-	-	1800 mW/m^2	30000	20
SBG	-	TS-PTFE	Al, Cu	PET	4.5 cm × 7 cm	84 V	28 μA	-	-	15.36 μW/cm^2	5000	268
egg white/HPMC	-	PTFE	Al	cardboard	-	120 V	12 μA	6.65 μW	50 nC	-	30000	25
snake ecdysis	RF sputtering	PTFE	Ag, Cu	PET	20 cm^2	120 V	160 μA	6250 μW	-	-	78000	117
chicken skin	-	Kapton	Al	PET	3 cm × 3 cm	123 V	20 μA	1.8 mW	-	0.2 mW/cm^2	52000	89

Other biomaterials	egg white	spin-coating	Kapton	Al	-	4 cm × 4 cm	1720 V	16.05 mA	105.26 W	-	328.84 mW/cm^2	-	112
	lignin	freeze-drying	FEP	carbon electrode	-	3 cm × 1.2 cm	208 V	60 μA	-	30 nC	4.86 W/m^2	10000	240
	sodium alginate	-	PVA	Al, Li	soluble adhesive tape	10-30 cm^2	1.47 V	3.9 μA	-	-	3.8 mW/m^2	-	242
	BNC	-	Cu, POM	Cu	PP, POM	5 cm × 5 cm	13 V	11 μA	-	-	4.8 mW/m^2	-	241
	TPS/glycerol	-	PDMS	carbon tape	PET	4.3 cm × 3.5 cm	560 V	0.18 mA	1.265 mW	-	17 W/m^2	4350	243
	chitosan-glycerol	coating	PTFE	Cu	acrylic plate	5 cm × 3 cm	130 V	15 μA	-	-	2.7 W/m^2	10000	248
	chitosan/acetic acid	-	Kapton	Cu	-	2 cm × 2 cm	1.2 V	60 μA	-	-	17.5 μW/m^2	-	244
	cellulose	spray-coating	PTFE	ITO	PET	2 cm × 2 cm	300 V	0.30 μA	-	-	15 W/m^2	10800	245
	BC/AgNWs/BTO	ultrasonication, vacuum filtration	PVDF	Cu	PI	2 cm × 2 cm	85 V	7.1 μA	-	35 nC	75 μW/cm^2	3000	246
	ACA	freeze-drying	PTFE	wire coils	-	2 cm × 2 cm	104 V	1.52 μA	-	-	694 mW/m^2	-	257
	paper	-	PTFE	Cu	-	2 cm × 2 cm	400 V	0.17 mA	-	26 nC	53 W/m^2	200000	247
	CCP	-	NCM	Cu	print paper	2.5 cm × 2.5 cm	196.8 V	31.5 μA	-	-	16.1 W/m^2	10000	249

	PLA/mPEG NFF	electrospinning	P(VDF–TrFE) NFF	Al	print paper	1 cm × 2 cm	342.8 V	38.5 μA	23.24 mW	-	116.21 W/m^2	10000	255
	NNF	electrospinning	FEP	Cu	acrylic plate, Kapton	3 cm × 3 cm	494 V	30 μA	-	189 nC	9.52 W/m^2	5000	254
Synthetic materials	SCL@(g-C3N4/PVA)	coating	PI	MXene@cotton electrode	Ecoflex	5 cm × 10 cm	720 V	134 μA	-	-	0.255 mW/cm^2	16000	256
	PI/MoS_2	spray-coating	PI	Al	PET, glass	1.5cm × 2.5cm	400 V	-	-	-	25.7 W/m^2	-	252
	skin	-	nickel-PDMS	GR	PU	1 cm × 3 cm	-	-	-	-	782.8 mW/m^2	500	251
	PVDF-TrFE/MXene	electrospinning	Nylon-11	conductive fabrics	acrylic sheet	diameter: 1.5 cm	270 V	-	-	-	4.02 W/m^2	20000	250

Nate: Voc = Open circuit voltage, Isc = Short circuit current, poly(ethylene oxide) (PEO),poly (vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP),Hydroxypropyl methyl cellulose (HPMC),polyvinyl chloride (PVC),printed circuit board (PCB),fluorinated ethylene propylene (FEP) ,collagen aggregate (CA) ,concanavalin A (ConA),collagen aggregate nanofibers (CA NFs),bead-chain-net poly(vinyl alcohol)/poly(vinylidene fluoride) nanofibers (B-C-N PVA/PVDF NFs),CA and acidified MWNTs NFs (CA-M NFs),gelatin-methacryloyl (GelMA),cellulose nanofibril/rabbit fur(CNF/RF),polyimide (PI),indium tin oxide (ITO), polyethylene terephthalate (PET),polyaniline/cellulose nanofibers(PANI/CA), chemical bath deposition (CBD) ,fish gelatin(FG),Acrylamide(AM) ,stearyl methacrylate (SMA) ,cellulose Nano Fiber (CNF),split black gram (SBG), thread sealant PTFE (TS-PTFE),glycerol-plasticized silk fibroin (RG) ,polyvinyl alcohol (PVA),polypyrrole cotton (PC),polyimide (PI),the extract of collagen (Col), oxidized hyaluronic acid (OHA) ,acrylic acid(AA),black wattle bark tannin (BWT),silver nanoparticles (AgNPs),ethylene glycol (EG), CN-silk (cyanoalkylated siloxane grafted silk), F-cotton (fluoroalkylated siloxane grafted cotton), regenerated silk fibroin fiber (RSFF), graphene (GR), bacterial nanocellulose (BNC), polyoxymethylene (POM), polypropylene (PP), thermoplastic starch (TPS), bacteria cellulose//BaTiO3(BC/AgNWs/BTO), crepe cellulose paper (CCP), nitrocellulose membrane (NCM), poly(lactic acid) nanofibrous membranes (PLA NFM), Nylon/Na2SO4 nanofiber film (NNF), poly(vinylidene fluoride-co-trifluoroethylene) nanofibrous film (P(VDF–TrFE) NFF), PLA/poly(ethylene glycol) monomethyl ether nanofibrous film (PLA/mPEG NFF), Ecoflex/g-C3N4 and Ecoflex/PVA based silicone composite layer (SCL@(g-C3N4/PVA)), aramid nanofiber (ANF)/CNF/silver nanowire (AgNW) (ACA), rice glutelin (pH-cycle) (RG (pH-cycle)), hydrogel by integrating fish gelatin into polymer networks with in-situ formation of silver nanoparticles (FG-Ag hydrogel), keratin/chitosan (CK).