The Beneficial of Bioplasma Technology

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หัวหน้าหน่วย Advance Wound Care Clinic
กองเวชศาสตร์ฟื้นฟู รพ.พระมงกุฎเกล้า

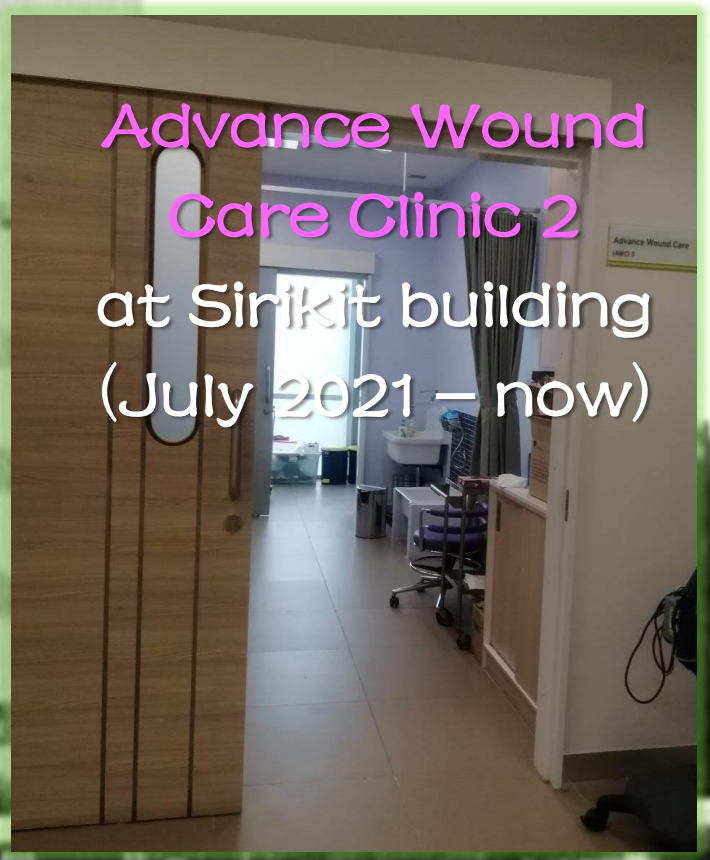
Advance Wound Care Clinic 1

Since 2012 until now

Advance Wound Care Clinic 2

at Sirikit building

(July 2021 – now)



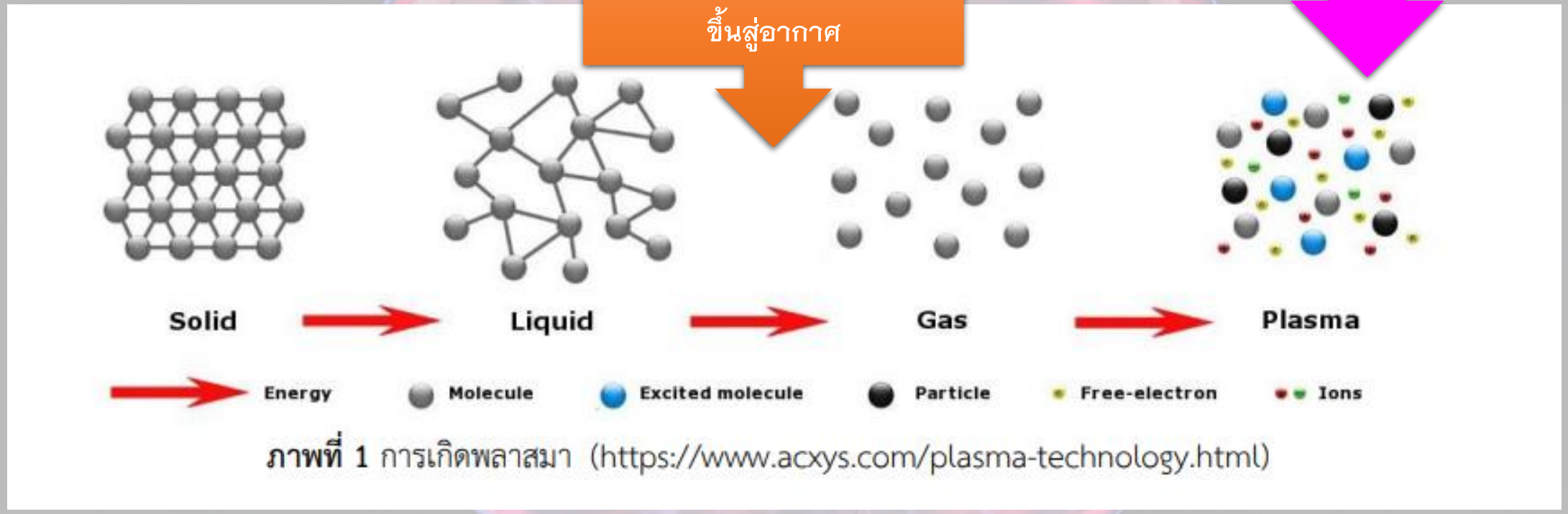
Physical Medicine and Rehabilitation (PM&R) Department

Maj. Jaraspas W.

สถานะที่ 4 ของสสาร

เมื่อของเหลวโดนอุณหภูมิสูง จะเปลี่ยนแปลงเป็นก๊าซลอยขึ้นสู่อากาศ

ได้รับความร้อนเพิ่มขึ้นอีกเล็กน้อย จะเกิดกระบวนการ Ionization ทำให้อิเล็กตรอนที่มีประจุลบหลุดออกมาจากอะตอม เหลือไว้เพียงแต่โปรตอนซึ่งมีไอออนประจุบวก



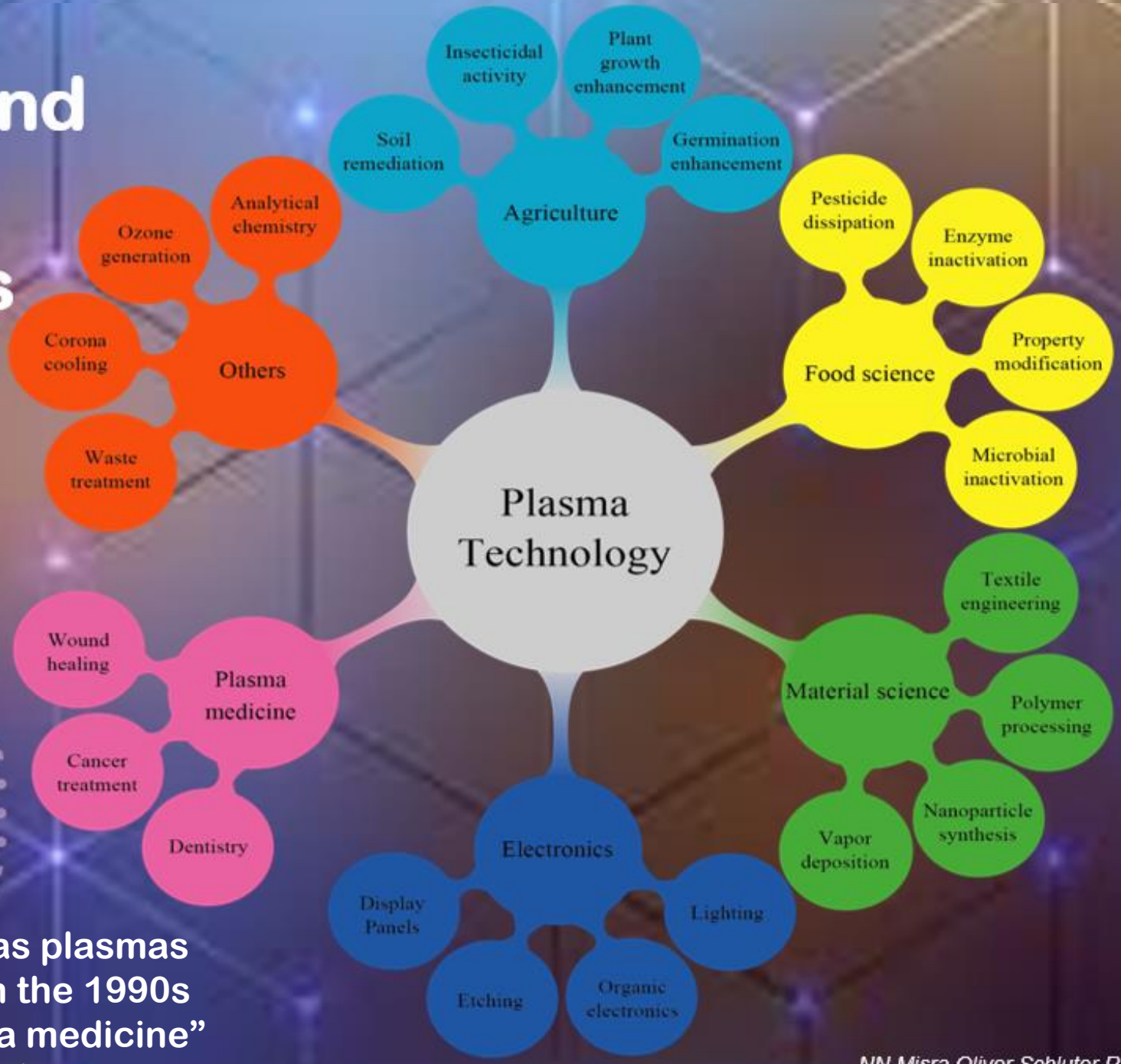
ภาพที่ 1 การเกิดพลาสมา (https://www.acxys.com/plasma-technology.html)

การผสมกันของประจุลบและประจุบวกซึ่งล่องลอยได้อย่างเป็นอิสระนี้เรียกว่า พลาสมา (Plasma)

- พลาสมาถูกสร้างขึ้นโดยการเพิ่มพลังงานให้กับแก๊สจนถึงจุดวิกฤตที่อิเล็กตรอนแยกออกจากอะตอม
- เนื่องจากก๊าซที่แตกตัวเป็นไอออนที่เกิดขึ้นนั้นมีอนุภาคที่มีประจุ (อิเล็กตรอนและไอออน) พลาสมาจึงนำไฟฟ้าได้ในขณะที่ประจุโดยรวมยังคงเป็นกลางทางไฟฟ้า
- ลักษณะเฉพาะของพลาสมาเคมีและฟิสิกส์มีความซับซ้อนขึ้นอยู่กับพารามิเตอร์หลายอย่าง เช่น ชนิดและองค์ประกอบของส่วนผสมของก๊าซหรือก๊าซที่ใช้สำหรับการสร้างพลาสมา พลังงานที่ใช้ ความดัน และสิ่งแวดล้อม
- อนุภาคทั่วไปที่ถูกสร้างขึ้น ได้แก่ ไอออน อิเล็กตรอน และสปีชีส์ของอะตอมและโมเลกุลที่มีปฏิกิริยาซึ่งสามารถมีประจุหรือเป็นกลางได้ สนามไฟฟ้าและสนามแม่เหล็กและแสง (มองเห็นได้, อินฟราเรด, อัลตราไวโอเลต) ก็ถูกสร้างขึ้นเช่นกัน

Plasma Science and Technology in Modern Industries

วิทยาศาสตร์และเทคโนโลยีพลาสมาในอุตสาหกรรมสมัยใหม่

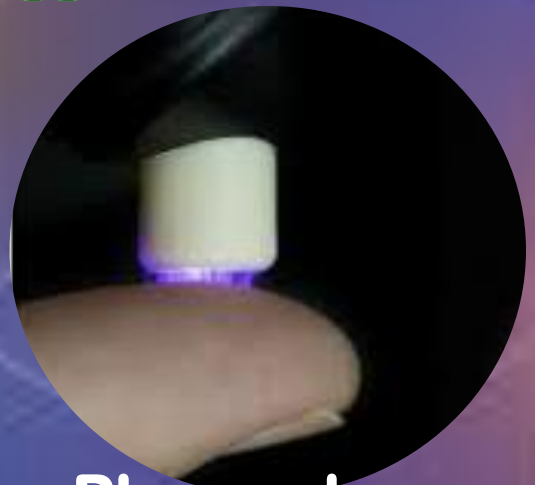


Plasma Medicine in Healthcare

The antimicrobial efficiency of gas plasmas started to become appreciated in the 1990s increasingly, and the term “plasma medicine” was subsequently coined

NN Misra Oliver Schluter PJ Cullen, 2016
Cold Plasma in Food and Agriculture: Fundamentals and Applications

Plasma Medicine



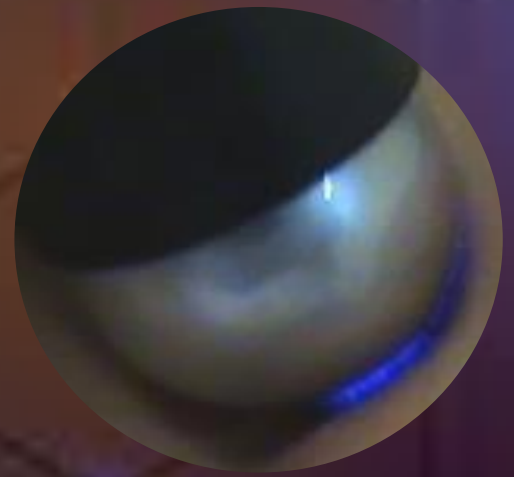
Plasmaderm

Bioplasma Jet with Argon

SteriPlas

KinPenMed

Bioplasma Jet with Helium



Bioplasma Air

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THE TERM REFERS TO PLASMA GASES

- Cold plasma (C.P.),
- Low-temperature plasma
- Cold Atmospheric Pressures Plasma (CAPP)
- **Non-Thermal Atmospheric Dielectric Barrier Discharge (DBD) Plasma**

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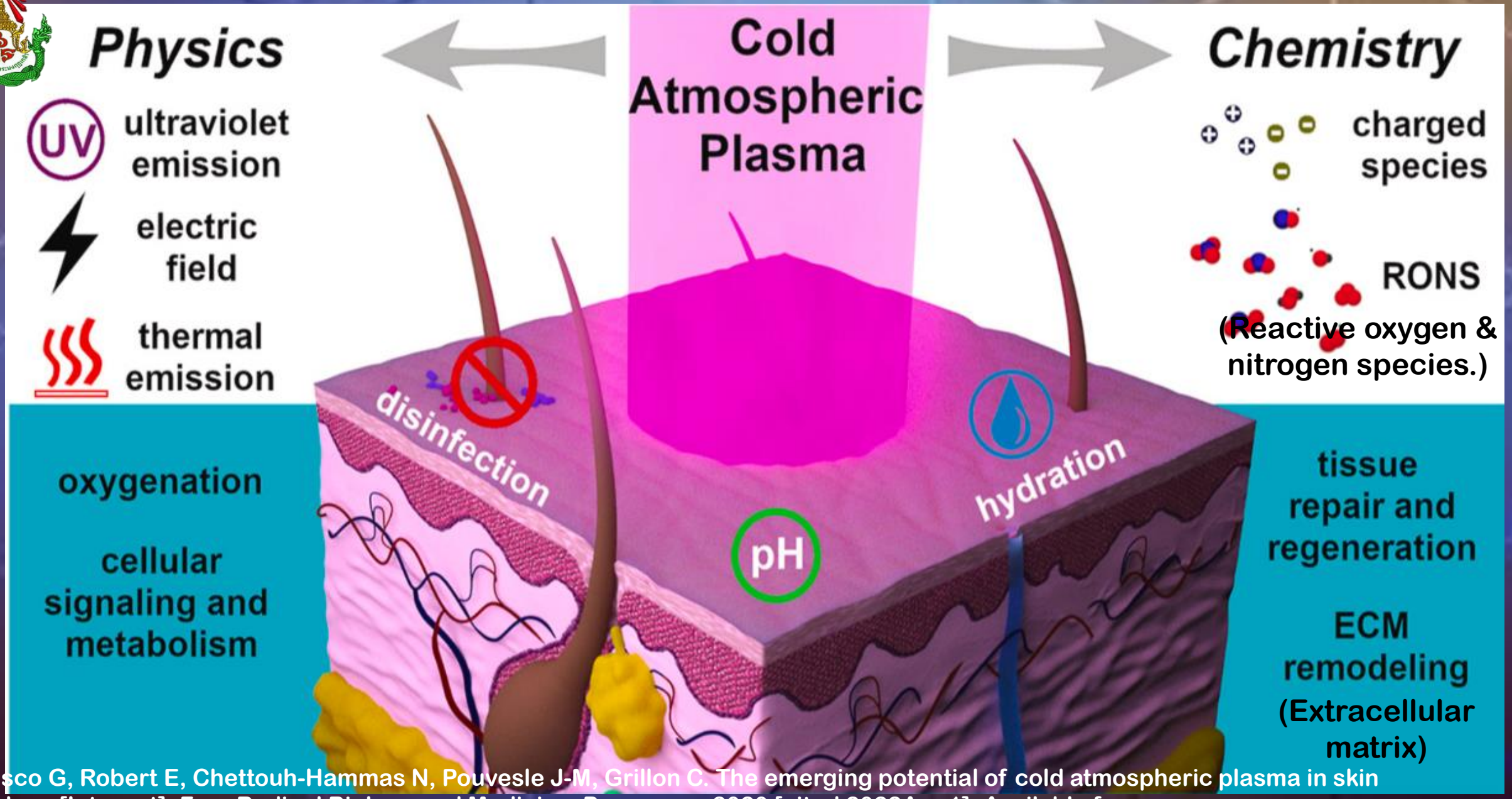
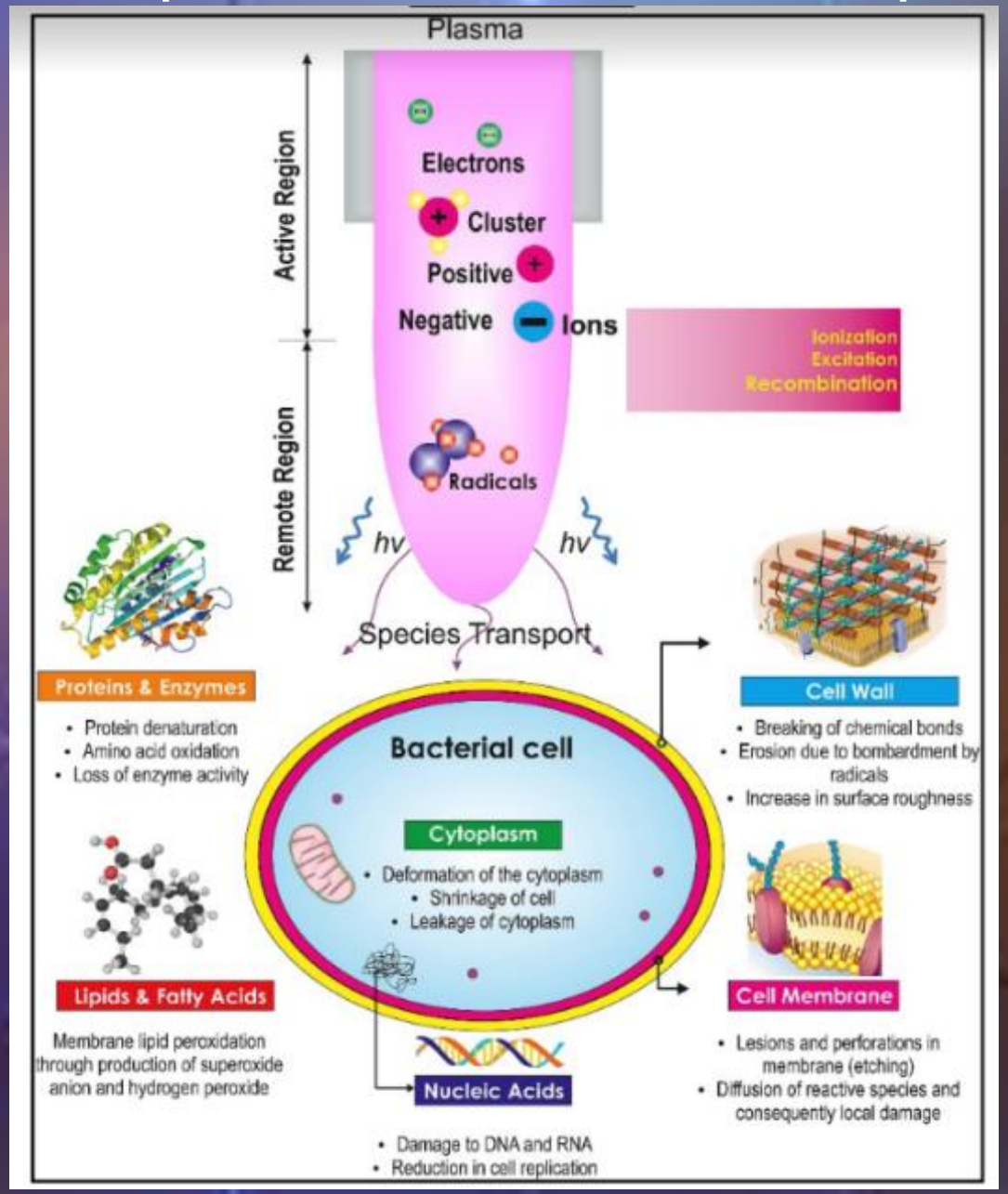


Busco G, Robert E, Chettouh-Hammas N, Pouvesle J-M, Grillon C. The emerging potential of cold atmospheric plasma in skin biology [Internet]. Free Radical Biology and Medicine. Pergamon; 2020 [cited 2022Aug1]. Available from: https://www.sciencedirect.com/science/article/pii/S0891584920312776

ผลของพลาสมาต่อจุลินทรีย์และสารชีวโมเลกุลต่าง ๆ ในระดับเซลล์



ที่มา: Misra and Cheorun (2017)

Benefit of Cold Plasma Technology

- Improves cell proliferation.
- Synthesis of Extracellular matrix protein.
- Promotes vascularization at wound site.
- Improved microcirculation.
- Restricts the spread of infectious microorganism.
- Stimulate Epithelialization

Dubey SK, Parab S, Alexander A, Agrawal M, Achalla VPK, Pal UN, et al. Cold Atmospheric Plasma therapy in wound healing [Internet]. Process Biochemistry. Elsevier; 2021 [cited 2022Jul31]. Available from: https://www.sciencedirect.com/science/article/abs/pii/S1359511321003421

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Randomized Controlled Trial > Int J Low Extrem Wounds. 2016 Dec;15(4):313-319.
doi: 10.1177/1534734616665046. Epub 2016 Sep 20.

The Healing Effect of Low-Temperature Atmospheric-Pressure Plasma in Pressure Ulcer: A Randomized Controlled Trial

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Affiliations + expand

PMID: 27581113 DOI: 10.1177/1534734616665046

Abstract

Pressure ulcers are difficult to treat. Recent reports of low-temperature atmospheric-pressure plasma (LTAPP) indicated its safe and effectiveness in chronic wound care management. It has been shown both in vitro and vivo studies that LTAPP not only helps facilitate wound healing but also has antimicrobial efficacy due to its composition of ion and electron, free radicals, and ultraviolet ray. We studied the beneficial effect of LTAPP specifically on pressure ulcers. In a prospective randomized study, 50 patients with pressure ulcers were divided into 2 groups: Control group received standard wound care and the study group was treated with LTAPP once every week for 8 consecutive weeks in addition to standard wound care. We found that the group treated with LTAPP had significantly better PUSH (Pressure Ulcer Scale for Healing) scores and exudate amount after 1 week of treatment. There was also a reduction in bacterial load after 1 treatment regardless of the species of bacteria identified.

BIOPlasmaJet: RCT-Chronic wound study outcome

		Study	Control
▪ Exudate reduction	1st wk	26.9%	0%
▪ Wound size reduction	2nd wk	46.2%	8.7%.
▪ Improve wound bed after	2ndwk	57.7%	8.7%
▪ Reduce bacterial load	1st wk	69.2%	17.3%.

%bacteria in Plasma Rx gr : P.Auriginosa 16, E.Coli 16, Acinetobacter baumannii 14, E.fisium 13,Kreb 10, MSSA 9, MRSA 7, Proteus 6, other 9

Conclusion :

Significant efficacy and safety in promote healing in chronic PU 8 wks PUSH score 96.2% 52.2%

Application :1min/ sqcm Scan mode, add on to conventional wound care.

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applied sciences

MDPI

Review

Cold Atmospheric Pressure Plasma in Wound Healing and Cancer Treatment

Lars Boeckmann [1,*], Mirijam Schäfer [1], Thoralf Bernhardt [1], Marie Luise Semmler [1], Ole Jung [1], Gregor Ojak [1], Tobias Fischer [1], Kirsten Peters [2], Barbara Nebe [2], Brigitte Müller-Hilke [3], Christian Seebauer [4], Sander Bekeschus [5] and Steffen Emmert [1]

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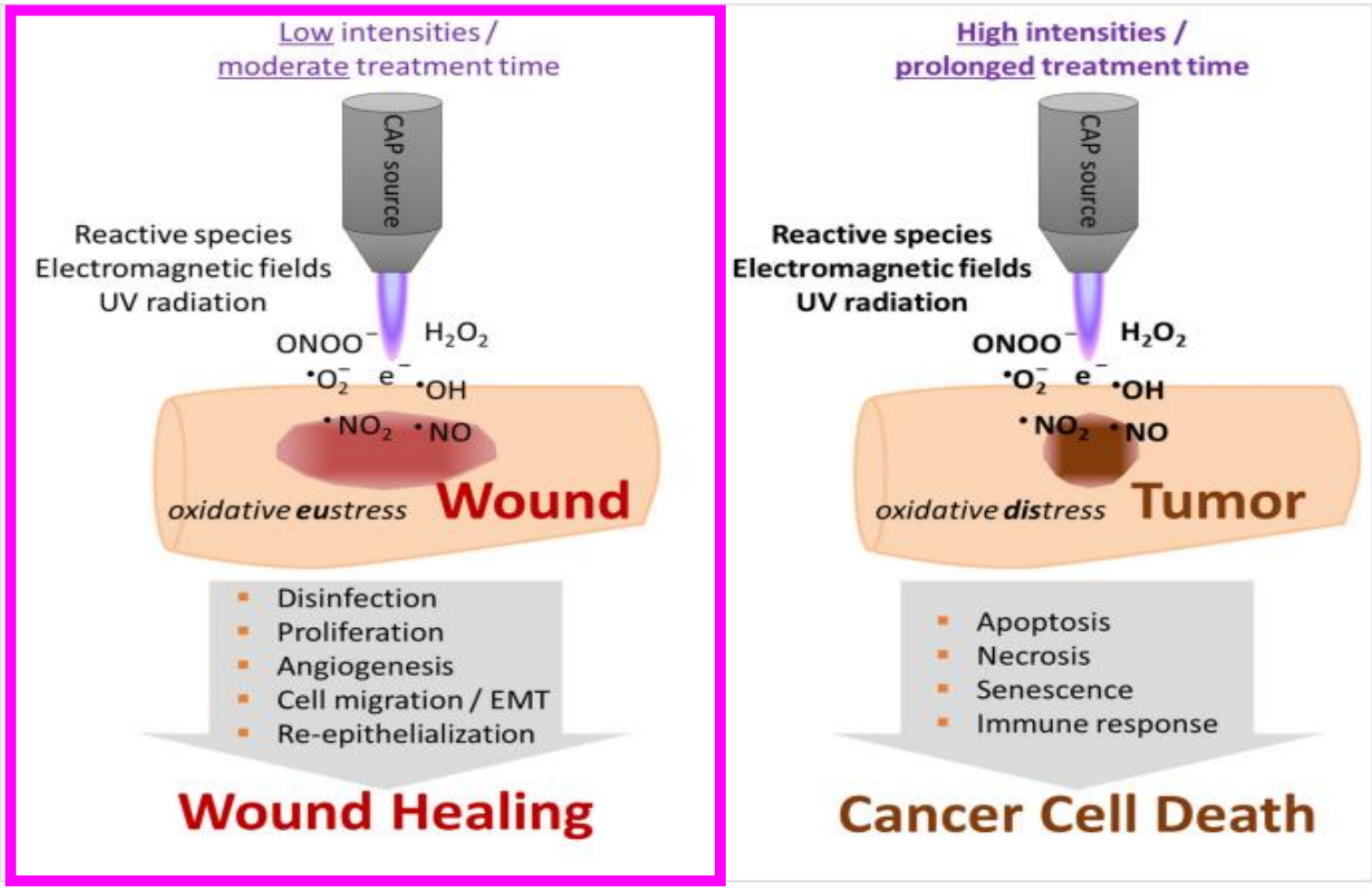


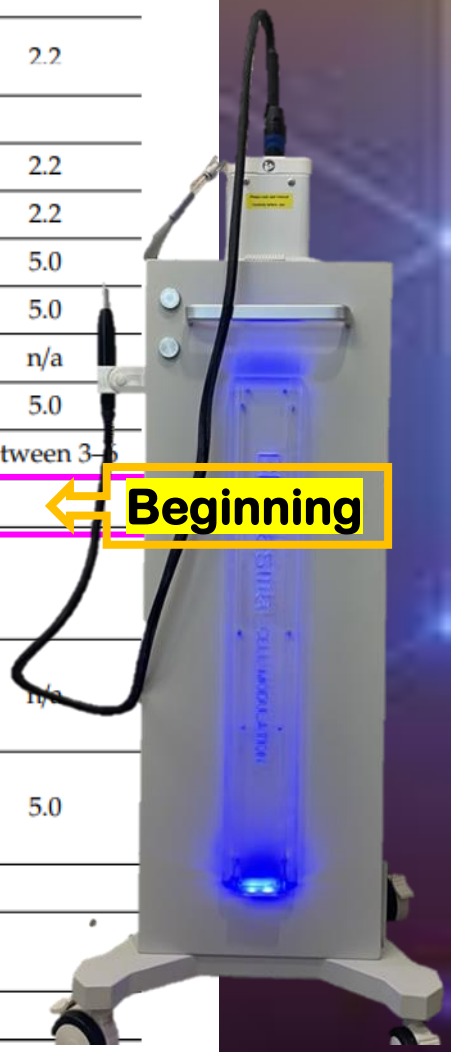
Figure 1. Cold atmospheric pressure plasma (CAP) in wound and cancer treatment. Wound healing, disinfection, and tissue regeneration are triggered by short or moderate CAP treatment (left panel). It is hypothesized that ultraviolet (UV) radiation, electromagnetic fields, and/or reactive oxygen and nitrogen species acting either alone or in concert contribute to the effects observed. Prolonged treatment for cancer therapy enhances oxidative stress from eustress to distress and hence will induce cancer cell death (right panel). EMT = epithelial-mesenchymal transition.

Boeckmann L, Schäfer M, Bernhardt T, Semmler ML, Jung O, Ojak G, et al. Cold atmospheric pressure plasma in wound healing and cancer treatment [Internet]. MDPI. Multidisciplinary Digital Publishing Institute; 2020 [cited 2022Jul31]. Available from: https://www.mdpi.com/2076-3417/10/19/6898

Table 2. Frequently reported treatment parameters in clinical pilot studies and case reports of CAP application for treatment of chronic and acute wounds, as well as (pre-) cancerous tissues.

Reference	Device	Type	Feed Gas	Treatment Time	Repetition	Distance	slm
[6]	MicroPlaSter α	Torch	Argon	5 min	daily (on average 7.86 treatments)	20 mm	2.2
[20]	CPC 1500 System (jet)	Jet	Helium	15–46 min	once		
[7]	MicroPlaSter α/β	Torch	Argon	2 min	daily (on average 11.75 treatments)		2.2
[13]	kINPen MED	Jet	Argon	10 s, 30 s, or 3×10 s	once	10 mm	
[10]	MicroPlaSter α/β	Torch	Argon	3–7 min	daily (on average 7.90 treatments)	20 mm	2.2
[16]	MicroPlaSter β	Torch	Argon	2 min	daily except for weekend	20 mm	2.2
[15]	kINPen MED	Jet	Argon	1 min (8 mm/s)	once	10 mm	5.0
[8]	kINPen 09	Jet	Argon	1 min/cm	once	7–8 mm	5.0
[11]	PlasmaDerm	DBD	n/a (air)	45 s/cm^2	3 × week for 8 weeks		n/a
[9]	kINPen MED	Jet	Argon	1 min/cm	3 × week for 2 weeks	7–8 mm	5.0
[21]	kINPen MED	Jet	Argon	1 min/cm^2	3 × week for 1 week	8 mm	between 3–5
[12]	BIOPlasma jet	Jet	Argon	1 min/cm^2	1 × week for 8 weeks	1–3 mm	
[22]	kINPen MED	Jet	Argon	Group I: 1 min spot exposure Group II: 3 min spot exposure	Group I: 3 × week for 1 weeks Group II: once	8 mm	
[23]	Custom-made device with hand-held electrode (FPG10-01NM10)	FE-DBD	n/a (air)	1–2 min	once	2.7 mm	n/a
[24]	kINPen MED	Jet	Argon	1 min/cm^2	3 × week for 1 week followed by an intermittence of 1 week without CAP	8 mm	5.0
[25]	Adtec Steri-Plas	Jet		2 min	2 × week (7 treatments)		
[18]	kINPen MED	Jet	Argon	30 s/cm^2	5 × daily, then 3 × every second day		
[19]	plasma jet	Jet	Helium	5 min	3 × week for 3 weeks	10 mm	

slm = standard liter per minute.



Intensity 05/ Frequency 50 Hz

Maj. Jaraspas W.


Thank
you