

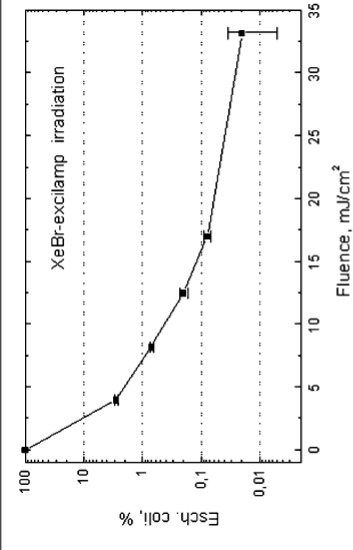
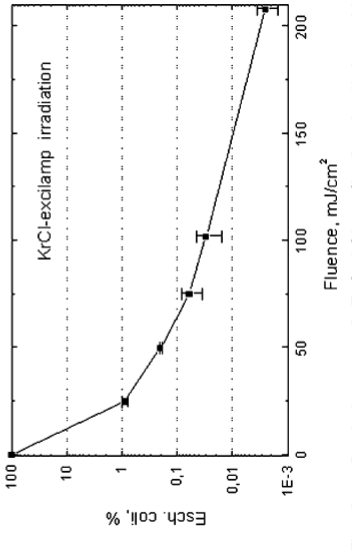
EXHIBIT F-17

The Effects of UV Irradiation and Gas Plasma Treatment on Living Mammalian Cells and Bacteria: A Comparative Approach, by Sosnin et al. (“Sosnin”) Invalidates the Asserted Claims of U.S. Patent No. 9,700,642

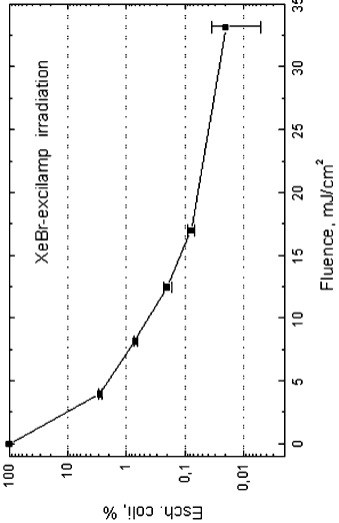
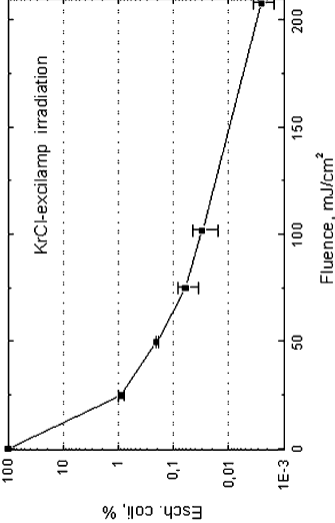
Asserted claims 1, 5, 7, 9, 12, 15, and 17 of U.S. Patent No. 9,700,642 (the “’642 Patent”) are invalid as anticipated and/or obvious in view of *The Effects of UV Irradiation and Gas Plasma Treatment on Living Mammalian Cells and Bacteria: A Comparative Approach*, by Sosnin et al. (“Sosnin”), alone or in combination with other prior art.¹

Claim No.	’642 Patent Claim Element	Sosnin
1[pre]	A process for destroying DNA or RNA of a microorganism on a substance or surface comprising the steps of:	At least based on Defendants’ interpretation of this claim element in their infringement contentions, to the extent the preamble is limiting, Sosnin discloses or renders obvious this element at least by disclosing, “Living mammalian cells and bacteria were exposed to irradiation from narrow-band UV lamps and treated with a nonthermal gas plasma (<i>plasma needle</i>). . . . UV irradiation can lead to cell death (necrosis) in fibroblasts, but the doses that can cause such damage are much higher than those needed to destroy <i>Escherichia Coli</i>. The usage of UV radiation in combination with active oxygen radicals lowers the UV dose sufficient to kill the cells.” Sosnin at Abstract. Sosnin also discloses, “Therefore, excilamps are suited to study wavelength-specific effects of UV radiation on various objects, including microorganisms. . . . As confirmed in our previous experiments [14], the XeBr-lamp is most efficient in sterilization. This is because the inactivation of bacteria is mainly related to the DNA/RNA damage, and the maximum absorption of DNA and RNA occurs at the photon wavelength between 240 and 300 nm.” <i>Id.</i> at 1545. Sosnin further discloses, “Irradiation with UV lamps may become a method of selective bacterial decontamination of wounds without killing the body cells that strive to repair the wound.” <i>Id.</i> at 1547.

¹ Healthe’s Invalidity Contentions are based, in part, upon Defendants’ interpretations of the Asserted Claims of the ’642 Patent, to the extent those interpretations can be discerned from Defendants’ Infringement Contentions in this case, which were served on February 24, 2021. Healthe disagrees with Defendants’ Infringement Contentions; these Invalidity Contentions are not, and should not be construed as, an endorsement or acceptance by Healthe of any of Defendants’ contentions or interpretations.

Claim No.	'642 Patent Claim Element	Sosnin
	Sosnin discloses this element in Figures 8 and 9:   Fig. 8. Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-exci lamp). Fig. 9. Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-exci lamp (222 nm). <i>Id.</i> at Figs. 8–9. <i>See also, e.g., id.</i> at 1544 (Introduction), 1547–49 (Results and Discussion), 1549 (Conclusion).	

Claim No.	'642 Patent Claim Element	Sosnin
1[a]	generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 222 nm and 282 nm;	At least based on Defendants' interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, "The XeBr-excilamp employed in our experiments produces a spectrum with an emission peak at $\lambda \sim 282$ nm and weak $D \rightarrow X$ and $C \rightarrow A$ bands. As confirmed in our previous experiments [14], the XeBr-lamp is most efficient in sterilization." <i>Id.</i> at 1545. Sosnin also discloses, "For comparison, we include typical bacterial survival curves, resulting from the irradiation of <i>E. Coli</i> with XeBr and KrCl ($\lambda = 222$ nm) excilamps (both developed in the High Current Electronics Institute, Toms)."<i>Id.</i> at 1547. Sosnin also discloses, "For comparison, we include typical bacterial survival curves, resulting from the irradiation of <i>E. Coli</i> with XeBr and KrCl ($\lambda = 222$ nm) excilamps (both developed in the High Current Electronics Institute, Toms)."<i>Id.</i> at 1547. Sosnin discloses this element in Figures 8 and 9:

Claim No.	'642 Patent Claim Element	Sosnin
		 Fig. 8. Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-exci lamp).  Fig. 9. Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-exci lamp (222 nm). <i>Id.</i> at Figs. 8–9. Sosnin discloses this element in Figure 2:

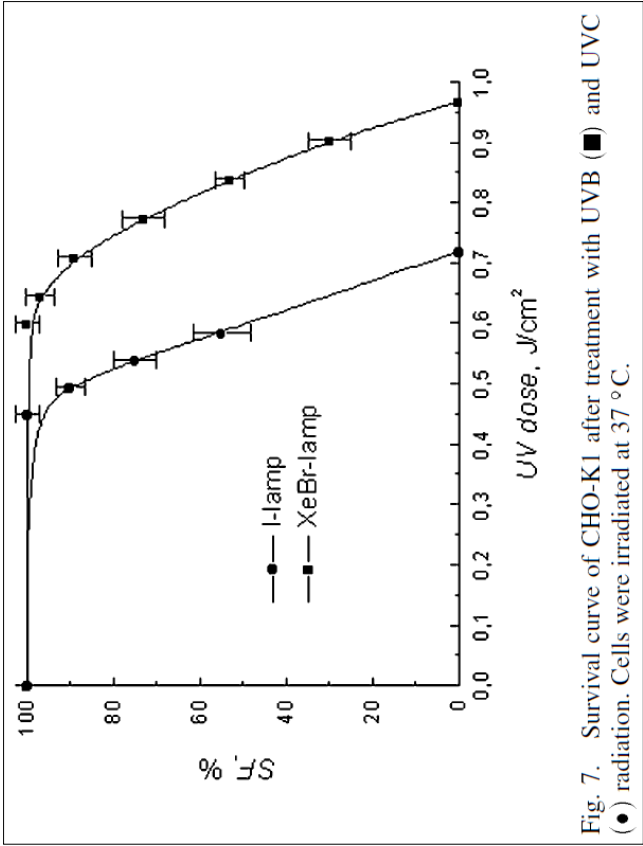
Claim No.	'642 Patent Claim Element	Sosnin
		Fig. 2. Emission spectra (range 200–500 nm) from two different UV light sources: (1) iodine lamp and (2) XeBr-excimer lamp.
		<i>Id.</i> at Fig. 2. See also, e.g., <i>id.</i> at 1545–46 (Ultraviolet Radiation Sources). In addition, based at least upon Defendants’ interpretation of this claim in their infringement contentions, this element would have been obvious to a POSITA based on the disclosures of Sosnin. Because Sosnin discloses irradiating a substance using XeBr and KrCl excimer sources, a POSITA would have found it obvious to generate photons at 222 nm or 282 nm for disinfecting surfaces because generating photons at such wavelengths was common and known to be effective for disinfection.
1[b]	directing the photons to the substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms;	At least based on Defendants’ interpretation of this claim element in their infringing contentions, Sosnin discloses or renders obvious this element at least by disclosing, “Living mammalian cells and bacteria were exposed to irradiation from narrow-band UV lamps and treated with a nonthermal gas plasma (<i>plasma needle</i>). . . . UV irradiation can lead to cell death (necrosis) in fibroblasts, but the doses that can cause such damage are much higher than those needed to destroy <i>Escherichia Coli</i>. The

Claim No.	'642 Patent Claim Element	Sosnin
	and	usage of UV radiation in combination with active oxygen radicals lowers the UV dose sufficient to kill the cells.” Sosnin at Abstract. Sosnin also discloses, “Therefore, excilamps are suited to study wavelength-specific effects of UV radiation on various objects, including microorganisms. . . . As confirmed in our previous experiments [14], the XeBr-lamp is most efficient in sterilization. This is because the inactivation of bacteria is mainly related to the DNA/RNA damage, and the maximum absorption of DNA and RNA occurs at the photon wavelength between 240 and 300 nm.” <i>Id.</i> at 1545. Sosnin further discloses, “Irradiation with UV lamps may become a method of selective bacterial decontamination of wounds without killing the body cells that strive to repair the wound.” <i>Id.</i> at 1547. Sosnin discloses this element in Figures 8 and 9:

Claim No.	'642 Patent Claim Element	Sosnin																														
		<table><caption>Data for Fig. 8: Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-excilamp)</caption><thead><tr><th>Fluence, mJ/cm²</th><th>Survival, %</th></tr></thead><tbody><tr><td>0</td><td>100</td></tr><tr><td>5</td><td>~40</td></tr><tr><td>10</td><td>~10</td></tr><tr><td>15</td><td>~0.5</td></tr><tr><td>20</td><td>~0.1</td></tr><tr><td>25</td><td>~0.05</td></tr><tr><td>30</td><td>~0.02</td></tr><tr><td>35</td><td>~0.01</td></tr></tbody></table> Fig. 8. Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-excilamp). <table><caption>Data for Fig. 9: Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-excilamp (222 nm)</caption><thead><tr><th>Fluence, mJ/cm²</th><th>Survival, %</th></tr></thead><tbody><tr><td>0</td><td>100</td></tr><tr><td>50</td><td>~10</td></tr><tr><td>100</td><td>~0.5</td></tr><tr><td>150</td><td>~0.1</td></tr><tr><td>200</td><td>~0.01</td></tr></tbody></table> Fig. 9. Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-excilamp (222 nm). <i>Id.</i> at Figs. 8–9. Sosnin additionally discloses, “In the view of future <i>in vivo</i> applications, UV treatment may provide a method to decontaminate tissues.” <i>Id.</i> at 1549. See <i>also, e.g., id.</i> at 1544 (Introduction), 1547–49 (Results and Discussion), 1549 (Conclusion); Fig. 7; Fig. 10.	Fluence, mJ/cm²	Survival, %	0	100	5	~40	10	~10	15	~0.5	20	~0.1	25	~0.05	30	~0.02	35	~0.01	Fluence, mJ/cm²	Survival, %	0	100	50	~10	100	~0.5	150	~0.1	200	~0.01
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Claim No.	'642 Patent Claim Element	Sosnin
1[c]	wherein the substance or surface to be disinfected is human or animal skin.	In addition, this element would have been obvious to a POSITA based on the disclosures of Sosnin. Because Sosnin discloses shining 206nm and 282nm wavelength photons on living mammalian cells and wounds to kill pathogens and discloses that 222nm (from KrCl) and 282nm (from XeBr) wavelength photons are effective for killing bacteria, it would have been obvious to use 222nm and/or 282 nm wavelength photons to disinfect human or animal skin, and a POSITA would have had a reasonable expectation of success in doing so. At least based on Defendants' interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, "Living mammalian cells and bacteria were exposed to irradiation from narrow-band UV lamps and treated with a nonthermal gas plasma (<i>plasma needle</i>). . . . UV irradiation can lead to cell death (necrosis) in fibroblasts, but the doses that can cause such damage are much higher than those needed to destroy <i>Escherichia Coli</i>. The usage of UV radiation in combination with active oxygen radicals lowers the UV dose sufficient to kill the cells." Sosnin at Abstract. Sosnin also discloses, "Irradiation with UV lamps may become a method of selective bacterial decontamination of wounds without killing the body cells that strive to repair the wound." <i>Id.</i> at 1547. Sosnin further discloses, "In the mentioned studies, UV and plasma treatment was performed <i>ex vivo</i>. One is reluctant to apply these media to living tissues because of the risk of cellular damage by UV [16] and radicals [17]. However, we have noticed that the lethal doses for bacteria are surprisingly low. Therefore, in this paper, we investigate the possibility of <i>in vivo</i> treatment, selective bacterial inactivation without harming the cells. For this purpose, one has to establish what doses of UV or plasma exposure can be applied without extensive tissue damage. We study the reaction of living mammalian cells to UV radiation, using narrow-band UV lamps (excilamps) and <i>Chinese Hamster Ovary</i> (CHO-K1) cells in culture as a model system. These cells are fibroblasts, a basal cell type, which is involved in many processes, e.g., wound repair. We compare the effects of UV radiation on cells with data on UV bacterial

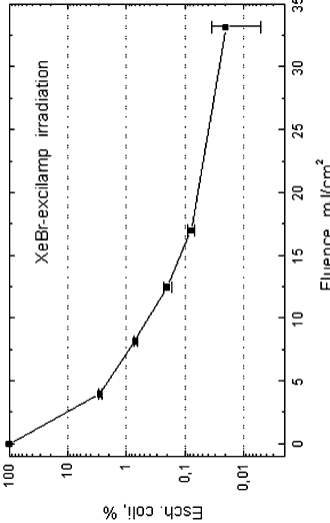
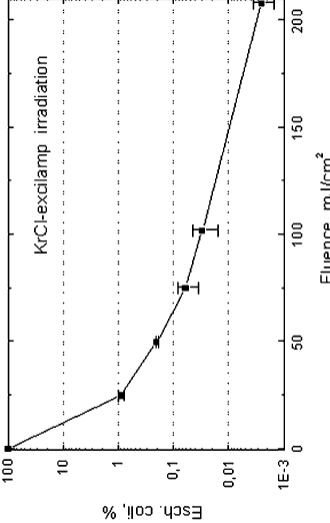
Claim No.	'642 Patent Claim Element	Sosnin
		deactivation. Furthermore, the case when irradiated cells are immersed in a hydrogen peroxide solution (a photosensitizer) is considered.” <i>Id.</i> at 1544. Sosnin additionally discloses, “In the view of future <i>in vivo</i> applications, UV treatment may provide a method to decontaminate tissues.” <i>Id.</i> at 1549. <i>See also, e.g., id.</i> at 1544 (Introduction), 1547–49 (Results and Discussion), 1549 (Conclusion); Fig. 7; Fig. 10. In addition, this element would have been obvious to a POSITA based on the disclosures of Sosnin. Because Sosnin discloses shining 206nm and 282nm wavelength photons on living mammalian cells and wounds to kill pathogens and discloses that 222nm (from KrCl) and 282nm (from XeBr) wavelength photons are effective for killing bacteria, it would have been obvious to use 222nm and/or 282 nm wavelength photons to disinfect human or animal skin, and a POSITA would have had a reasonable expectation of success in doing so.
5	The process of claim 1 wherein the step of directing the photons further comprises directing the photons to provide a radiant dose energy of 40 mJ/cm² to the substance or surface to be disinfected.	At least based on Defendants’ interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious the process of claim 1. <i>See</i> Claim 1. At least based on Defendants’ interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, “The lethal UV doses (no survivors) for the fibroblasts are 1 J/cm² for UVB and 0.7 J/cm² for UVC radiation.” <i>Id.</i> at 1549. Sosnin also discloses, “Excilamps provide UV irradiance up to 10 mW/cm² and their efficiency is typically 7%–30%.” <i>Id.</i> at 1545. Sosnin further discloses, “UV radiation was dosed by varying the treatment time between 2 and 5 min, while the lamp irradiance was kept constant at 4 mW/cm² for the

Claim No.	'642 Patent Claim Element	Sosnin
		XeBr lamp and 3 mW/cm² for the I-lamp. All experiments were repeated at least three times.” <i>Id.</i> at 1546. Sosnin additionally discloses, “UV treatment of <i>E. Coli</i> bacteria was performed in Toms; Petri dishes with <i>E. Coli</i> cultures were irradiated from several seconds to several minutes at a 5-cm distance and at different levels of UV irradiance (up to 10 mW/cm²). Each exposure was repeated four to five times.” <i>Id.</i> at 1546. Sosnin discloses this element in Figures 7 - 9:  Fig. 7. Survival curve of CHO-K1 after treatment with UVB (■) and UVC (●) radiation. Cells were irradiated at 37 °C.

Claim No.	'642 Patent Claim Element	Sosnin
		Figure 8: Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-exci lamp). The graph shows a log-linear relationship between survival percentage and fluence. The y-axis is 'Esch. coli, %' on a log scale from 100 to 0.01. The x-axis is 'Fluence, mJ/cm²' from 0 to 35. Data points are connected by a line, showing a sharp drop in survival after 10 mJ/cm². Figure 9: Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-exci lamp (222 nm). The graph shows a log-linear relationship between survival percentage and fluence. The y-axis is 'Esch. coli, %' on a log scale from 100 to 0.01. The x-axis is 'Fluence, mJ/cm²' from 0 to 200. Data points are connected by a line, showing a gradual decrease in survival up to 100 mJ/cm², followed by a steeper decline. See also, e.g., <i>id.</i> at 1547–49 (Results and Discussion), 1549 (Conclusion), Fig. 6. In addition, this element would have been obvious to a POSITA based on the disclosures of Sosnin. Because Sosnin discloses that at least 0.25 J/cm² (250 mJ/cm²) of both 206 nm and 282 nm wavelength photons can be shined on living mammalian cells without killing any of these cells, discloses that more than 50 mJ/cm² of 222nm wavelength photons (from KrCl) is needed to kill 99.9% of <i>Escherichia coli</i> bacteria, and indicates that approximately 40 mJ/cm² of 282nm wavelength photons (from

Claim No.	'642 Patent Claim Element	Sosnin
		XeBr) is needed to kill 99.99% of <i>Escherichia coli</i> bacteria, a POSITA would have been motivated to provide a radiant dose energy of 40 mJ/cm ² to human or animal skin to disinfect it.
7	The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 10 mJ/cm ² to the substance or surface to be disinfected.	Sosnin discloses or renders obvious the process of claim 1. See Claim 1. At least based on Defendants' interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, "The lethal UV doses (no survivors) for the fibroblasts are 1 J/cm² for UVB and 0.7 J/cm² for UVC radiation." <i>Id.</i> at 1549. Sosnin also discloses, "Excilamps provide UV irradiance up to 10 mW/cm² and their efficiency is typically 7%–30%." <i>Id.</i> at 1545. Sosnin further discloses, "UV radiation was dosed by varying the treatment time between 2 and 5 min, while the lamp irradiance was kept constant at 4 mW/cm² for the XeBr lamp and 3 mW/cm² for the I-lamp. All experiments were repeated at least three times." <i>Id.</i> at 1546. Sosnin additionally discloses, "UV treatment of <i>E. Coli</i> bacteria was performed in Toms; Petri dishes with <i>E. Coli</i> cultures were irradiated from several seconds to several minutes at a 5-cm distance and at different levels of UV irradiance (up to 10 mW/cm²). Each exposure was repeated four to five times." <i>Id.</i> at 1546. Sosnin discloses this element in Figures 7 - 9:

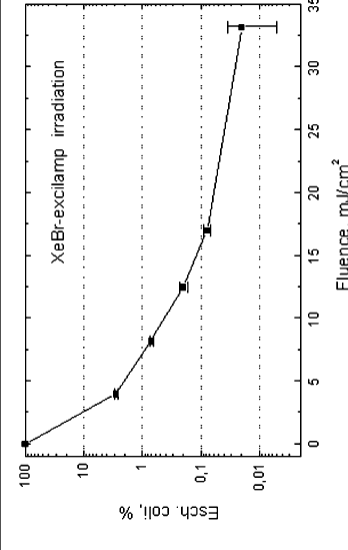
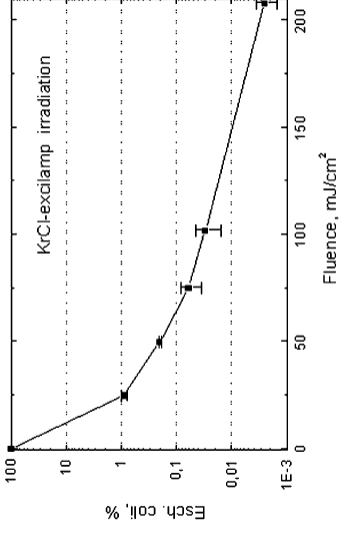
Claim No.	'642 Patent Claim Element	Sosnin																																				
		Fig. 7. Survival curve of CHO-K1 after treatment with UVB (■) and UVC (●) radiation. Cells were irradiated at 37 °C. <table border="1"> <caption>Estimated data points from Fig. 7</caption> <thead> <tr> <th>UV dose (J/cm²)</th> <th>SF, % (I-lamp)</th> <th>SF, % (XeBr-lamp)</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>100</td><td>100</td></tr> <tr><td>0.1</td><td>95</td><td>98</td></tr> <tr><td>0.2</td><td>90</td><td>95</td></tr> <tr><td>0.3</td><td>85</td><td>90</td></tr> <tr><td>0.4</td><td>80</td><td>85</td></tr> <tr><td>0.5</td><td>75</td><td>80</td></tr> <tr><td>0.6</td><td>65</td><td>70</td></tr> <tr><td>0.7</td><td>55</td><td>60</td></tr> <tr><td>0.8</td><td>45</td><td>50</td></tr> <tr><td>0.9</td><td>35</td><td>40</td></tr> <tr><td>1.0</td><td>25</td><td>30</td></tr> </tbody> </table>	UV dose (J/cm²)	SF, % (I-lamp)	SF, % (XeBr-lamp)	0.0	100	100	0.1	95	98	0.2	90	95	0.3	85	90	0.4	80	85	0.5	75	80	0.6	65	70	0.7	55	60	0.8	45	50	0.9	35	40	1.0	25	30
UV dose (J/cm²)	SF, % (I-lamp)	SF, % (XeBr-lamp)																																				
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		 Fig. 8. Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-exci lamp).  Fig. 9. Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-exci lamp (222 nm). See also, e.g., <i>id.</i> at 1547–49 (Results and Discussion), 1549 (Conclusion), Fig. 6. In addition, this element would have been obvious to a POSITA based on the disclosures of Sosnin. Because Sosnin discloses that at least 0.25 J/cm² (250 mJ/cm²) of both 206 nm and 282 nm wavelength photons can be shined on living mammalian cells without killing any of these cells, discloses that approximately 10 mJ/cm² of 222nm wavelength photons (from KrCl) is needed to kill 90% of <i>Escherichia coli</i> bacteria, and discloses that more than 10 mJ/cm² of 282nm wavelength photons (from

Claim No.	'642 Patent Claim Element	Sosnin
		XeBr) is needed to kill 99.9% of <i>Escherichia coli</i> bacteria, a POSITA would have been motivated to provide a radiant dose energy of 10 mJ/cm ² to human or animal skin to disinfect it.
9	The process of claim 1 wherein the step of directing the photons further comprises exposing the substance or surface to be disinfected to the generated photons for less than 0.1 second.	Sosnin discloses or renders obvious the process of claim 1. See Claim 1. At least based on Defendants' interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, "The lethal UV doses (no survivors) for the fibroblasts are 1 J/cm² for UVB and 0.7 J/cm² for UVC radiation." <i>Id.</i> at 1549. Sosnin also discloses, "Excilamps provide UV irradiance up to 10 mW/cm² and their efficiency is typically 7%–30%." <i>Id.</i> at 1545. Sosnin further discloses, "UV radiation was dosed by varying the treatment time between 2 and 5 min, while the lamp irradiance was kept constant at 4 mW/cm² for the XeBr lamp and 3 mW/cm² for the I-lamp. All experiments were repeated at least three times." <i>Id.</i> at 1546. Sosnin additionally discloses, "UV treatment of <i>E. Coli</i> bacteria was performed in Toms; Petri dishes with <i>E. Coli</i> cultures were irradiated from several seconds to several minutes at a 5-cm distance and at different levels of UV irradiance (up to 10 mW/cm²). Each exposure was repeated four to five times." <i>Id.</i> at 1546. Sosnin cites to <i>The development of photosensitized pulsed and continuous ultraviolet decontamination techniques for surface and solutions</i>, by McDonald et al., IEEE Trans. Plasma Sci., vol. 28, pp. 89–96, Feb. 2000. Sosnin cites to <i>Inactivation of food-borne enteropathogenic bacteria and spoilage fungi using pulsed-light</i>, by Anderson et al., IEEE Trans. Plasma Sci., vol. 28, pp. 83–87,

Claim No.	'642 Patent Claim Element	Sosnin
	Feb. 2000. Sosnin discloses this element in Figures 8 and 9: Fig. 8. Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-excilamp). Fig. 9. Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-excilamp (222 nm). <i>Id.</i> at Figs. 8–9. <i>See also, e.g., id.</i> at 1547–49 (Results and Discussion), 1549 (Conclusion), Figs. 6–7.	

Claim No.	'642 Patent Claim Element	Sosnin
		In addition, based at least upon Defendants' interpretation of this claim in their infringement contentions, this element would have been obvious to a POSITA in view of Sosnin's disclosures. Because Sosnin discloses irradiating a substance using 222 nm and/or 282 nm wavelength photons and cites to studies in which pulsed UV light was used for disinfection, a POSITA would have found it obvious to expose the substance or surface to be disinfected to the generated photons for less than 0.1 seconds, because the photon emission disclosed by Sosnin was known to be capable of destroying or deactivating DNA or RNA of a microorganism within that period of time, particularly at higher irradiance levels. Therefore, a POSITA would have been motivated to only expose the surface to the generated photons for less than 0.1 seconds to minimize the treatment time. A POSITA would have found modifying Sosnin's disclosures to allow for sub-0.1 second exposure times, if necessary, to have been routine and would have had a reasonable expectation of success in making any such modifications.
12[pre]	A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:	At least based on Defendants' interpretation of this claim element in their infringement contentions, to the extent the preamble is limiting, Sosnin discloses or renders obvious this element at least by disclosing, "Living mammalian cells and bacteria were exposed to irradiation from narrow-band UV lamps and treated with a nonthermal gas plasma (<i>plasma needle</i>). . . . UV irradiation can lead to cell death (necrosis) in fibroblasts, but the doses that can cause such damage are much higher than those needed to destroy <i>Escherichia Coli</i>. The usage of UV radiation in combination with active oxygen radicals lowers the UV dose sufficient to kill the cells." <i>Id.</i> at Abstract. Sosnin also discloses, "Therefore, excilamps are suited to study wavelength-specific effects of UV radiation on various objects, including microorganisms. . . . As confirmed in our previous experiments [14], the XeBr-lamp is most efficient in sterilization. This is because the inactivation of bacteria is mainly related to the DNA/RNA damage, and the maximum absorption of DNA and RNA occurs at the photon wavelength between 240 and 300 nm." <i>Id.</i> at 1545.

Claim No.	'642 Patent Claim Element	Sosnin
		Sosnin further discloses, “Irradiation with UV lamps may become a method of selective bacterial decontamination of wounds without killing the body cells that strive to repair the wound.” <i>Id.</i> at 1547. Sosnin discloses this element in Figures 8 and 9:  Figure 8 is a line graph titled "XeBr-exci lamp irradiation". The y-axis is labeled "Esch. coll. %" and ranges from 100 down to 0.01 on a logarithmic scale. The x-axis is labeled "Fluence, mJ/cm²" and ranges from 0 to 35. The data points show a sharp decline in survival, reaching approximately 0.01% at 35 mJ/cm².  Figure 9 is a line graph titled "KrCl-exci lamp irradiation". The y-axis is labeled "Esch. coll. %" and ranges from 100 down to 0.01 on a logarithmic scale. The x-axis is labeled "Fluence, mJ/cm²" and ranges from 0 to 200. The data points show a steady decline in survival, reaching approximately 0.01% at 200 mJ/cm². <i>Id.</i> at Figs. 8–9.

Claim No.	'642 Patent Claim Element	Sosnin
12[a]	generating photons of at least two single line wavelengths corresponding to a peak absorption wavelength of DNA or RNA, the at least two single line wavelengths being at least two of 222 nm, 254 nm and 282 nm; and	<i>See also, e.g., id.</i> at 1547–49 (Results and Discussion), 1549 (Conclusion). At least based on Defendants’ interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, “The XeBr-excilamp employed in our experiments produces a spectrum with an emission peak at $\lambda \sim 282$ nm and weak $D \rightarrow X$ and $C \rightarrow A$ bands. As confirmed in our previous experiments [14], the XeBr-lamp is most efficient in sterilization.” <i>Id.</i> at 1545. Sosnin also discloses, “For comparison, we include typical bacterial survival curves, resulting from the irradiation of <i>E. Coli</i> with XeBr and KrCl ($\lambda = 222$ nm) excilamps (both developed in the High Current Electronics Institute, Toms).” <i>Id.</i> at 1547. Sosnin further discloses, “The main feature which distinguishes excilamps from other UV sources is that their spectra consist of narrow bands (the band halfwidth rarely exceeds 5–8 nm). . . . By varying the composition of the working mixture it is possible to select a required wavelength.” Sosnin discloses this element in Figures 8 and 9:

Claim No.	'642 Patent Claim Element	Sosnin																										
		<table border="1"><caption>Data for Figure 8</caption><thead><tr><th>Fluence, mJ/cm²</th><th>Esch. coll., %</th></tr></thead><tbody><tr><td>0</td><td>100</td></tr><tr><td>5</td><td>~10</td></tr><tr><td>10</td><td>~1</td></tr><tr><td>15</td><td>~0.2</td></tr><tr><td>20</td><td>~0.05</td></tr><tr><td>32</td><td>~0.005</td></tr></tbody></table> Fig. 8. Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-exci lamp). <table border="1"><caption>Data for Figure 9</caption><thead><tr><th>Fluence, mJ/cm²</th><th>Esch. coll., %</th></tr></thead><tbody><tr><td>0</td><td>100</td></tr><tr><td>50</td><td>~10</td></tr><tr><td>100</td><td>~1</td></tr><tr><td>150</td><td>~0.1</td></tr><tr><td>200</td><td>~0.001</td></tr></tbody></table> Fig. 9. Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-exci lamp (222 nm). <i>Id.</i> at Figs. 8–9. Sosnin discloses this element in Figure 2:	Fluence, mJ/cm²	Esch. coll., %	0	100	5	~10	10	~1	15	~0.2	20	~0.05	32	~0.005	Fluence, mJ/cm²	Esch. coll., %	0	100	50	~10	100	~1	150	~0.1	200	~0.001
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		Fig. 2. Emission spectra (range 200–500 nm) from two different UV light sources: (1) iodine lamp and (2) XeBr-excilamp. <i>Id.</i> at Fig. 2. See also, e.g., <i>id.</i> at 1545–46 (Ultraviolet Radiation Sources). In addition, based at least upon Defendants’ interpretation of this claim in their infringement contentions, this element would have been obvious to a POSITA based on the disclosures of Sosnin. Sosnin discloses using excimer lamps emitting at 222 nm and 282 nm for disinfection and discloses the benefits of each wavelength. A POSITA would have thus found it obvious to modify Sosnin, if necessary, to generate both 222 nm and 282 nm wavelength photons in order to achieve the benefits of both wavelengths and would have had a reasonable expectation of success in doing so.
12[b]	directing the photons to the substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA	At least based on Defendants’ interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, “Living mammalian cells and bacteria were exposed to irradiation from narrow-band UV lamps and treated with a nonthermal gas plasma (<i>plasma needle</i>). . . . UV irradiation can lead to cell death (necrosis) in fibroblasts, but the doses that can cause

Claim No.	'642 Patent Claim Element	Sosnin
	or RNA of the microorganisms.	such damage are much higher than those needed to destroy <i>Escherichia Coli</i>. The usage of UV radiation in combination with active oxygen radicals lowers the UV dose sufficient to kill the cells.” Sosnin at Abstract. Sosnin also discloses, “Therefore, excilamps are suited to study wavelength-specific effects of UV radiation on various objects, including microorganisms. . . . As confirmed in our previous experiments [14], the XeBr-lamp is most efficient in sterilization. This is because the inactivation of bacteria is mainly related to the DNA/RNA damage, and the maximum absorption of DNA and RNA occurs at the photon wavelength between 240 and 300 nm.” <i>Id.</i> at 1545. Sosnin further discloses, “Irradiation with UV lamps may become a method of selective bacterial decontamination of wounds without killing the body cells that strive to repair the wound.” <i>Id.</i> at 1547. Sosnin discloses this element in Figures 8 and 9:

Claim No.	'642 Patent Claim Element	Sosnin
		Fig. 8. Survival curve of <i>Escherichia coli</i> irradiated with UVB (XeBr-excilamp). Fig. 9. Survival curve of <i>Escherichia coli</i> after irradiation with a KrCl-excilamp (222 nm). <i>Id.</i> at Figs. 8–9. <i>See also, e.g., id.</i> at 1547–49 (Results and Discussion), 1549 (Conclusion). In addition, based at least upon Defendants’ interpretation of this claim in their infringement contentions, this element would have been obvious to a POSITA based on the disclosures of Sosnin. Sosnin discloses using excimer lamps emitting at 222 nm and 282 nm for disinfection. A POSITA would have thus found it obvious to modify

Claim No.	'642 Patent Claim Element	Sosnin
		Sosnin, if necessary, to direct 222 nm and 282 nm wavelength photons to a surface or substance to be disinfected, and a POSITA would have had a reasonable expectation of success in doing so.
15	The process of claim 12 wherein the step of directing the photons further comprises directing the photons to provide a radiant dose energy of 40 mJ/cm ² to the substance or surface to be disinfected.	Sosnin discloses or renders obvious the process of claim 12. See Claim 12. At least based on Defendants' interpretation of this claim element in their infringement contentions, Sosnin discloses or renders obvious this element at least by disclosing, "The lethal UV doses (no survivors) for the fibroblasts are 1 J/cm² for UVB and 0.7 J/cm² for UVC radiation." <i>Id.</i> at 1549. Sosnin also discloses, "Excilamps provide UV irradiance up to 10 mW/cm² and their efficiency is typically 7%–30%." <i>Id.</i> at 1545. Sosnin further discloses, "UV radiation was dosed by varying the treatment time between 2 and 5 min, while the lamp irradiance was kept constant at 4 mW/cm² for the XeBr lamp and 3 mW/cm² for the I-lamp. All experiments were repeated at least three times." <i>Id.</i> at 1546. Sosnin additionally discloses, "UV treatment of <i>E. Coli</i> bacteria was performed in Toms; Petri dishes with <i>E. Coli</i> cultures were irradiated from several seconds to several minutes at a 5-cm distance and at different levels of UV irradiance (up to 10 mW/cm²). Each exposure was repeated four to five times." <i>Id.</i> at 1546. Sosnin discloses this element in Figures 7 - 9:

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