Reactive Nanoparticles

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Introduction:

Wetsuits can act as a sponge and trap water borne materials, this behavior can become especially hazardous for divers swimming in contaminated waters. A potential method of improving the antimicrobial performance of wetsuits without hindering overall performance is through the impregnation nanoparticles such as Ag, TiO_2, and ZnO nanoparticles. Ag ions have been known to inhibit the growth of micro organisms, and it is believed that these Ag nanoparticles will be effective in reducing the hazards, posed by diving in contaminated waters, due to their high surface area and reactivity. Furthermore these inorganic materials are desirable due to the reduced tendency to create microbial resistances to antibiotics [1]. The focus of the current work is to understand the antimicrobial behavior of unaltered wetsuits to serve as a base for the rest of the study.

Procedure:

Three different wetsuits were used in the experiement. One consisted of a Neoprene core and a nylon exterior, another was a polyester spandex composite and the last was a nylon spandex composite. Samples were washed in a isopropyl bath for 15min then allowed to dry for 24 hours. Controls were preformed by inocculating 42mm diameter wetsuit samples with 1ml solution consisting of Trypticase Soy Broth (TSB) and *Staphylococcus Aureus.* that had been allowed to grow for 24 hours*.* Interaction between the bacteria and the wetsuit was stopped at 0min, 10min and 20min marks using 0.02M $Na_2S_2O_3$ solution as a neutralizing agent. Samples for each time were diluted by 10 times and 100 times. Dilutions were spread onto Trypticase Soy Agar (TSA) plates and the *S. aureus* was then allowed to incubate at 37°C for 24 hours. The number of colony forming units were then counted and normalized by dividing by the initial bacteria concentration.

Results and Discussion:

Figure 1 shows the relative decrease of bacteria conentration on the various wetsuits over a 20min period. Images of the Neoprene/Nylon and Nylon/Spandex wetsuit surfaces are shown respecfully in figure 2.

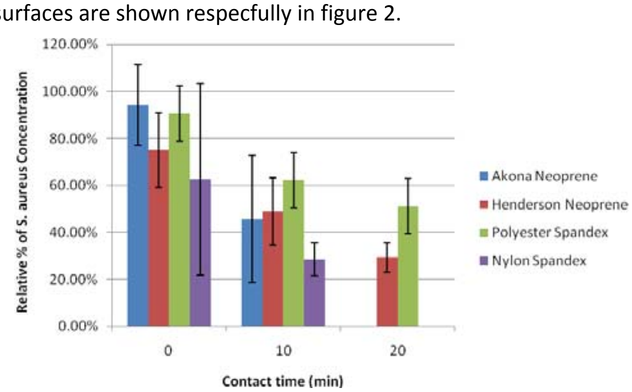
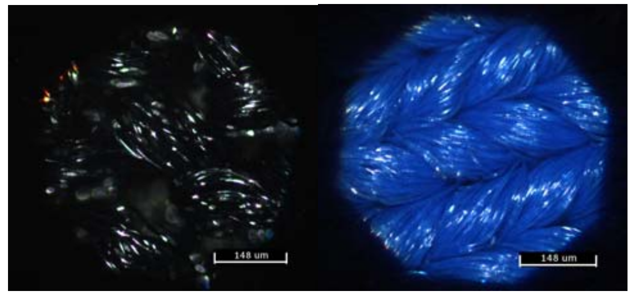


Figure 1: relative % reduction of *S. aureus*



(A) (B)

Figure 2: 50x magnification of, (A) Neoprene/Nylon, (B) Nylon/Spandex [3].

Shown from figure 1, in the case of all the materials *S. aureus* concentraions decrease gradually after exposure. This is most likely due to the nature of the experiment. Prolonged exposure to the wetsuit samples resulted in a deficit of available nutrients causing the concentration to decrease. The Akona Neoprene and Henderson Neoprene samples had a 51% and 34% reduction respectfully in bacteria concentration while the Polyester/Spandex material had a 31% reduction. This difference can be attributed to the increased thickness of the neoprene, allowing it to easily hold the bacteria solution. Through a standard t-test, it is seen that between 0 min and 20min there is a 99% and 95% chance for live bacteria concentration decrease for the Neoprene/Nylon and the polyester/spandex composite respectively. Although the Nylon/Spandex material showed great reduction in concentration, the deviation at 0min is too great to draw any conclusions. Wetsuit surfaces that are shown in Figure 2 display even fiber distributions thus not affecting the absorbance of bacterial solution during the experiment.

Conclusion:

It can be reasonably concluded that live bacteria concentration decrease as expsoure time increases, especially from the 0min to 20min time period. Further testing on the Nylon/Spandex material is needed to reduce error. Future work would include comparing nanoparticles altered wetsuits with these controls.

Acknowledgements

I would like to thank Dr. David Stollberg for all the guidance throughout the project, Dr. Jie Xu for showing me how to use all the lab equipment. I would also like to thank Melissa Sever for working with me on this project.

Refrences:

[1] K.H. Cho, J.E. Park & T.Osaka, "The study of antimicrobial activity and preservative effects of nanosilver ingredient," *Electrochimica Acta*, vol. 51, no. 5, pp. 956–960, Nov 2005.
[2] Kim, J. S., E. Kuk, et al. (2007). "Antimicrobial effects of silver nanoparticles." *Nanomedicine: Nanotechnology, Biology and Medicine* vol. **3** no. 1, pp.95-101.
[3] courtesy of Juan Aguilar