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Dual purpose antimicrobial phase change materials

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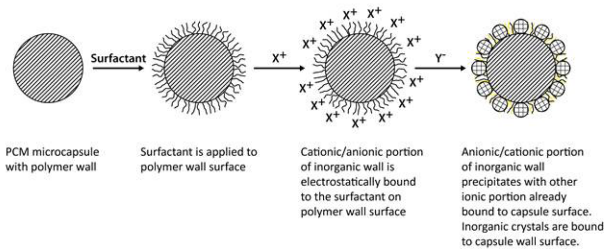
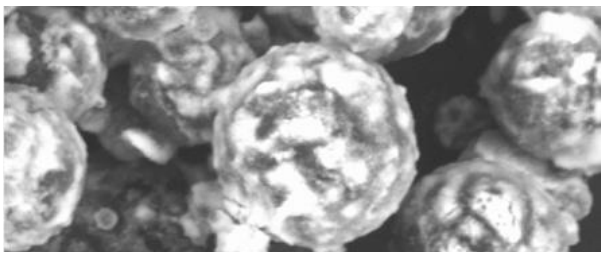
The healthcare industry, sports and fitness industry, and military (naming a few) all require thermal comfort as well as protection from microbial growth and infection when engaging in coinciding treatments, athletic performances and job tasks. Through recent innovation by Microtek Labs, the ability to provide thermal regulation in conjunction with antimicrobial properties has been achieved by tethering a silver (I) coating to the wall of a microencapsulated phase change material (PCM) using a surfactant. The coated PCM microcapsule can be easily incorporated into various coatings, resins, solvent based and aqueous based systems. The duality of thermal comfort in combination with microbial inhibition and resistance is achievable in an area that is approximately $2.7x10^{-7}$ cm^3. The PCM provides thermal comfort and regulation while the silver (I) coating provides protection against microbial growth and infection. In further explanation, a PCM is a substance with a high heat of fusion capable of storing and releasing large amounts of energy through a phase transition around a certain temperature. PCMs are classified as latent heat storage units. Latent heat storage is typically utilized during the solid-liquid transitions in thermal storage applications. PCM's can be microencapsulated for easy incorporation into innumerable applications. Microencapsulated PCMs are currently being used in a wide variety of fields and industries including textiles, mattress and bedding, electronics, building and construction, paints and coatings, supply chain, medical, food and beverage, automotive, spacecraft thermal systems, and solar power plants. The coating of the PCM microcapsules using silver (I) is to aide in the prevention and mitigation of microbial growth and infection. A growing and developing problem with many antimicrobial products is microbial resistance to the antimicrobials. According to the World Health Organization, antimicrobial resistance is threatening the effective prevention of infections caused by microbes, where antimicrobial resistant bacteria are causing a high percentage of infections acquired in hospitals. Ionized Silver (I) is an antimicrobial that has shown no increase in antimicrobial resistance. Silver (I) is detrimental to microbial cells without causing harm to animal cells. Historically, the antimicrobial activity of silver (I) was utilized in WWI to prevent infections in wounds of soldiers. In current literature, silver nanoparticles are being incorporated into clothing and textiles to prevent odors associated with bacterial and fungal growth found in sweat. The inability to effectively tether these nanoparticles to textiles causes them to wash out over time. Coating a particle, such as a microencapsulated PCM (Or other micro-carrier), in silver (I) allows for easy incorporation and application into a diverse array of substrates. This can include textile coatings used to tether the particles to the fabric, paints, resins, solvent and aqueous based systems, and a variety of additional substrates for expansive industrial uses. The unique incorporation of microencapsulated PCM with a silver (I) coating allows for thermal regulation, antimicrobial protection and easy substrate dispersion.





To demonstrate the silver coating is in fact, coating the PCM capsules, SEM images are provided above in **Figure 1.** In the SEM images, silver appears brighter and white, as the electron density of silver is much higher than that of the organic microcapsule wall. From this, the silver coating is very well attached to the PCM microcapsules.

Biography

Carl M Lentz has been the Director of New Technology Development since 2012 at Microtek Laboratories, Inc., in Dayton, OH, USA, working to improve and develop new microencapsulation techniques and products. He graduated from James Madison University with a degree in Chemistry. He did his PhD from the Johns Hopkins University in Synthetic Organic Chemistry and Biochemistry. He has experience in both laboratory and production scaled projects in companies such as Eastman Kodak and Ferro Corporation with his most recent work at Microtek Laboratories Inc.

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