Effective Antimicrobial Protection for Automotive Composite Applications
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Introduction

Automotive manufacturers, like individuals, businesses, and local, state, and federal agencies are looking for effective methods of protection against harmful and disease-bearing bacterial and viral pathogens that could exist in their vehicles. While the Coronavirus disease 2019 (Covid-19) pandemic presents new and unprecedented challenges to our society, our current responses have been mostly defensive, i.e., individual masks and disinfectants for surfaces that come near to human contact. It is known, however, that humans in close contact spaces, like automobiles, run a higher risk of exposure to these pathogens. The interior automotive spaces certainly qualify for a higher risk environment. As an industry and concerned consumers, we need to address how to protect automotive composite applications such as headliners, IP components, and other interior trim components from the spread of harmful pathogens.

What are harmful pathogens; a brief introduction

Recently, there has been an undeniable increase in the amount of discussions related to health, safety, and microbial defense. To understand what effects a microorganism can have on the human body it is vital to grasp a fundamental knowledge of what a pathogen is, where pathogens are found, and how pathogens are transmitted. Pathogens are organisms that are naked to the human eye and contain the capability of causing disease and illness to any living body. The outcomes associated with infection from these pathogens can range from being minor to life-threatening and or lethal. There are various categories of pathogens and each of the microscopic organisms that belong to a particular subset consists of distinct structural characteristics which helps for further differentiation and classification of individual pathogens. Viruses, bacteria, fungi, protozoa and prions are all considered pathogens however the most widely recognized pathogens include Viruses and Bacteria. With that said, not all of these microscopic organisms are deemed pathogenic and it is important to note that the human body relies on certain pathogens such as bacteria and protozoa to carry out normal and necessary actions related to the immune system and digestive tract.

Pathogenic microscopic organisms on the other hand, thrive to bring harm to humans by entering a host, evading the immune system's defenses, replicating, or reproducing within a host and then escaping via indirect or direct transmission. In the case

of indirect transmission, which appears to be the major concern related to the COVID-19 pandemic, an individual comes in contact with some sort of a surface, inanimate object, or vector that contained the pathogen and that transmission was the result of contact involving bodily fluid transfer, airborne inhalation, oral consumption or vector transmission.

As society finds itself in a world that functions around transportation it comes as no surprise that these pathogenic or harmful microscopic organisms can easily attach to vehicle surfaces including the steering wheel, dashboard, door handles, consoles and entire interior of vehicles as a whole. The major concern related to this is that as individuals spend time commuting in their vehicles, they are essentially in a confined space that may very well be a breeding ground for many of the pathogenic microscopic organisms that wreak havoc on the immune system, and cause disease or illness.

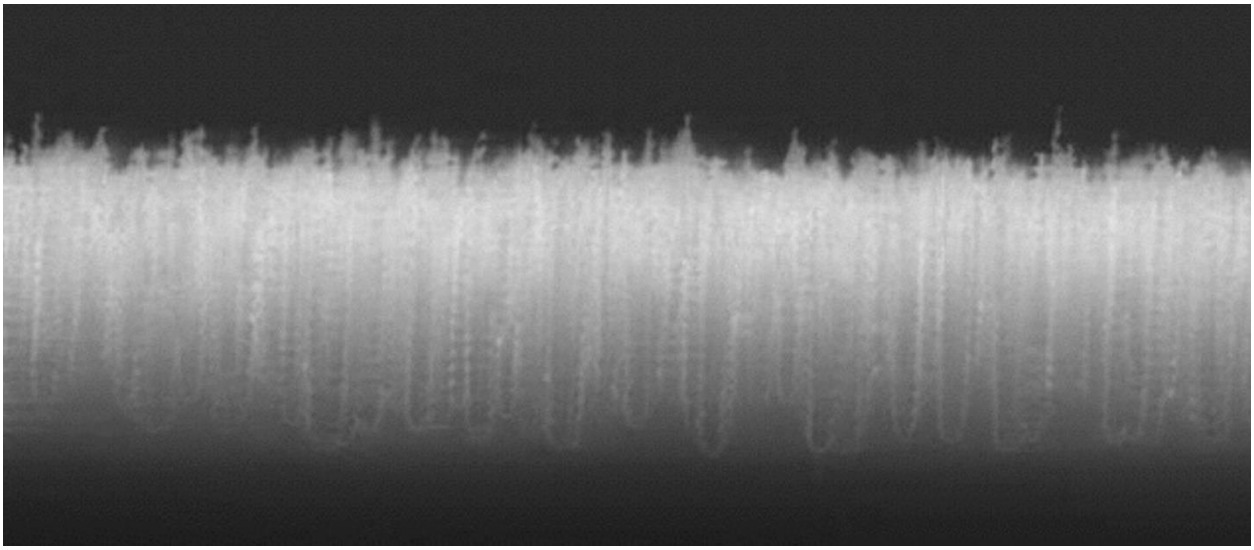
How humans try to protect themselves

While medical science grapples with developing an effective antiviral vaccine, we must rely on utilizing effective out-of-body protection methods. Traditional methods of protection are to attack the harmful microorganisms with varying degrees of biocide and somewhat poisonous chemicals. These chemicals, composed of alcohols, bleaches and acids, are designed to target and destroy a microbe's outer membrane (see above), resulting in a "chemical kill". Thus, in order to work effectively, the chemicals must be applied directly on the harmful pathogens. Unfortunately, when most of the antimicrobial biocides used today encounter skin or are ingested at certain concentrations and amounts, the toxic compounds have proven to be harmful to humans, plants, and domestic animals. It is for this very reason that the need for a safer alternative to combating pathogenic microscopic organisms is so crucial.

A new and more effective antimicrobial methodology

There exist today antimicrobial products that have been developed to (1) kill harmful pathogens and (2) provide longer and effective protection than traditional disinfectant treatments. This is done by an arrangement of the active antimicrobial ingredients into a robust and durable nano crystalline-like protective barrier that can be deposited on the surfaces that need protection. What is a nano crystalline-like barrier? In layman's terms, it is a densely populated layer of microscopic nano molecules similar in shape to crystals that exhibit increased strength/toughness, durability vs. traditional materials, and provide an effective barrier protection for many surfaces. The nano crystalline-like structures form a covalent bond with the surface it encounters which increases its longer lasting durability and provides a denser, more effective protective barrier. A few of these nano crystalline-

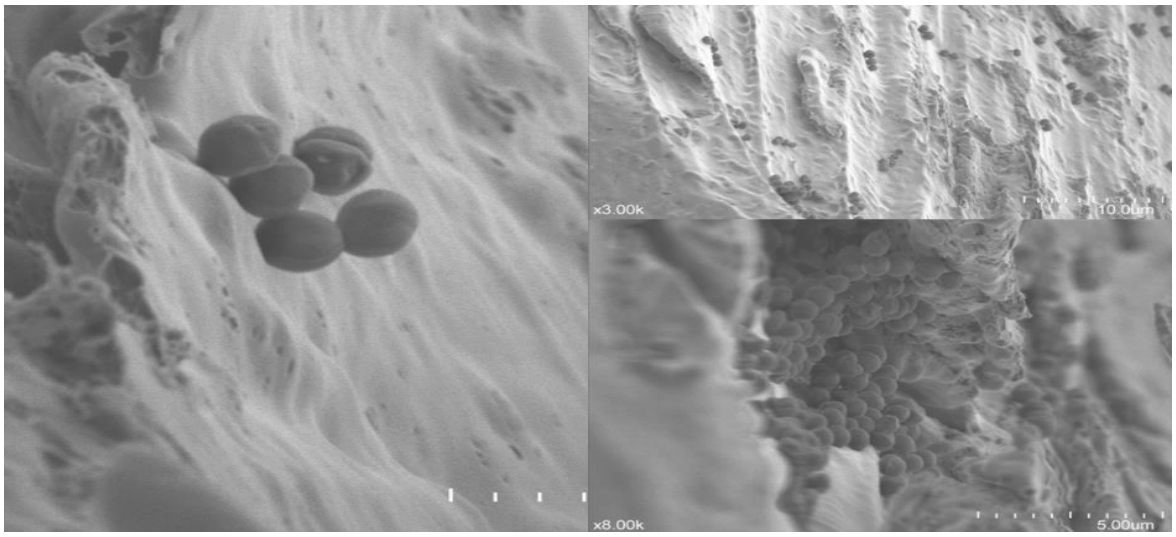
like materials take a step further by incorporating non-alcohol-based disinfectants that offer a “killer” defense against harmful bacteria, viruses, fungi, and protozoa, thus creating a longer lasting protection.



Under a microscope, the nano crystalline-like structures appear as a continuous, “spikey” surface where the sharp spikes present an anti-microbial infused barrier to harmful bacteria, viruses, and pathogens, (kind of like “popping” a balloon). Since the nano crystalline-like carrier is comprised of microscopic structures, i.e., smaller than the viral pathogens, it develops an effective barrier.

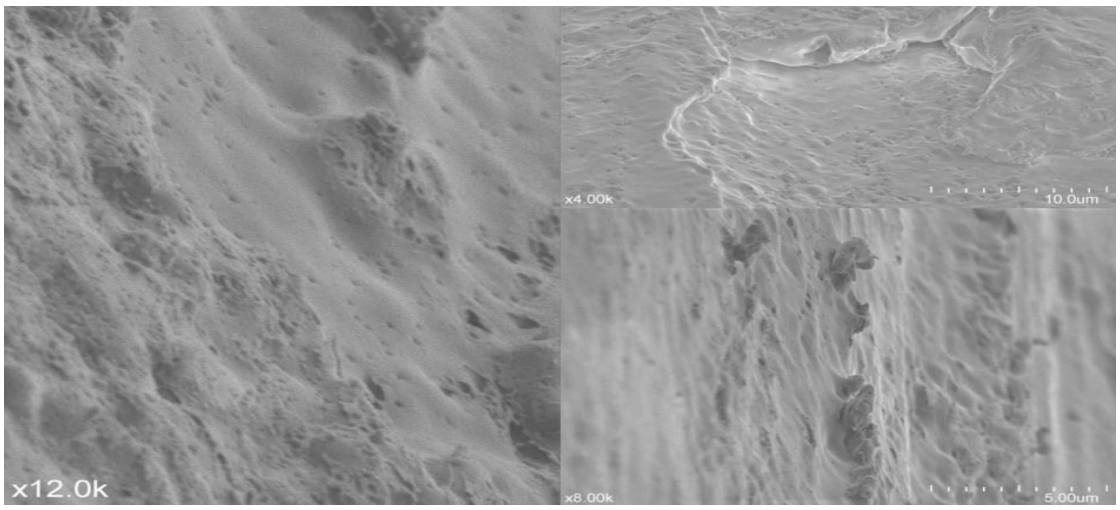
How Does It work? The Ingredients

Nano crystalline-like structures are very small particles, invisible to the naked eye, and can be effectively applied to a variety of surfaces, including human skin. Thicknesses of barriers, when applied to surfaces evenly and sparingly, are nanometers thick (Hence the name; 1 nano meter equals 0.00004”). However, thin as the layer may be, it is composed of densely populated atomic-sized crystals that form a difficult impenetrable barrier for other small sized “invaders” such as harmful pathogens. Now, a durable, longer lasting effective protective barrier and antimicrobial behaving system is created. A long-lasting antimicrobial is added to the nano crystalline-like particles thus creating an effective “mechanical kill” defense that has a longer lasting effectiveness vs. a traditional surface “chemical kill” biocide.



The microscopic pictures show the pathogens (dark spheres) impaled on the nano crystalline-like protected surface.

The antimicrobial active ingredient, captured in the barrier membrane, creates a biocidal action that creates a dissociation of the unwanted outer pathogen's membrane cover thus creating a leakage of its cellular contents. Robbed of its outer protective membrane, this effectively kills or damages the harmful microbes so that they are no longer capable of infecting.



The action of the antimicrobial nano crystalline-like defense system coupled with disinfectant kills off the attacking pathogens.

The Application

The antimicrobial products are applied to surfaces via a fine spray or foam mist spray technique. The mist and foam application provides an even and thin layer distribution. The mist spray method is generally used for larger areas of protection, while the foam spray can be concentrated on smaller areas. In either method, the use of a fine mist spray application will effectively coat most continuous surfaces, including fabric-type and composite applications, such as FG/resin headliners. Fine mist spraying devices come in a variety of operating styles, hand or electric pump, disposable or reusable, and designed for larger or more concentrated areas. A light, but fully coated or wet out area of coverage will achieve a desirable protection level. The antimicrobial solution air dries quickly after forming the desired barrier protection level, kills pathogens on contact, and provides a longer lasting protective level of protection.

More About Plastics & Composites

The surface polarity of plastics will play a part in how effective the antimicrobial nanocrystalline coating adheres. Many plastics offer a sufficient surface polarity for surface application. Some plastics, Olefins in particular (polyethylene and polypropylene), have low surface polarity, and as such, may need surface polarity enhancements. This can be accomplished by using primer-type coatings or the use of “plasma-type or corona” surface treatments. In any case, the manufacturer’s surface protectant antimicrobial application protocol should be followed.

Summary

The development of multi-levels of disinfectant protection from harmful pathogens should be considered by OEM’s, car rental agencies, and individual vehicle owners as a near term defense. Anti-microbial products that can provide longer term robust and disinfectant protection are now beginning to be available in the market place. Still care, social distancing, and disinfectant protection are widely recommended.

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I am a member, Board of Directors, International Society of Plastics Engineers (SPE) Automotive and Composites Divisions. Past Chairman, 2001 & 2004 SPE Automotive Composites Conference & Exposition (ACCE), SPE Honored Service Award – 2003; SPE Composites Person of the Year, 2008; SPE Automotive Division Lifetime Achievement Recipient, 2015; Licensed Professional Engineer (Pennsylvania).

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Dr. Hamid A. Khan is a graduate of Avalon University School of Medicine, who has an extensive background in medical related research. Dr. Khan is a proud Chicago native who attended Loyola Academy High School in Wilmette, Illinois and completed his undergraduate studies at Lake Forest College. While at Lake Forest College, Dr. Khan played four years of NCAA collegiate football and was the starting defensive cornerback for the duration of that time. In medical school, Dr. Khan served as a microbiology tutor, student mentor, social chair, and was named the Chief Medical Scholar while completing his medical rotations at Adventist Hospital in Hinsdale, Illinois. Dr. Khan has received several awards for his work in the field of medicine and has made it a point to focus his attention on injury risk, prevention, and management. He is passionate about volunteer work and has had the opportunity to help many underprivileged patients outside of the United States by dedicating his time to annual medical and surgical mission trips. Currently, Dr. Khan serves as the Chief of Research and Compliance at Strategia, a company dedicated to developing unique and novel antimicrobial solutions. With numerous orthopedic related publications and published medical literature that has been referenced throughout an abundance of studies, Dr. Khan is hopeful that his role in the field of medicine will be one that leads to a safer and healthier world to live in.