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HEALTH in BUILDINGS
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May 27-29, 2026 - Island of KOS, Greece

#	**Alexandros Zoikis - Karathanasis** Chemical Engineer, PhD, MSc	
Title:	CEO Creative Nano PC	
email:	Alexkar1978@hotmail.com	
Presentation title:	**Visible Light-Activated Antibacterial Coatings for Healthier Indoor Environments**	

This work presents two complementary visible light-activated antibacterial coating technologies designed to improve hygiene and air quality in indoor environments: electroplated metallic composite coatings for high-touch metal surfaces, and acrylic paints incorporating hybridized TiO_2-based photocatalytic pigments. Both systems rely on modified TiO_2 nanoparticles engineered to operate under indoor lighting, enabling the generation of reactive oxygen species (ROS) that contribute to antibacterial performance and pollutant degradation.

The metallic coatings integrate doped TiO_2 nanoparticles within electroplated layers suitable for door handles, knobs and frequently touched metallic building components. Their photocatalytic activation under visible light supports continuous surface sanitization without altering the usability or aesthetics of the underlying hardware. In parallel, the acrylic paint formulations employ sulfur-doped and silica-stabilized TiO_2 nanostructures optimized for band-gap tuning, controlled porosity and enhanced visible-light absorption. As demonstrated in previous evaluations, these nanoparticles show effective degradation of model pollutants such as methyl orange and acetaldehyde, with supporting data from hydrodynamic size analysis, band-gap measurements and photocatalytic performance tests.

Fundamental concepts of photocatalysis underpin both systems, including visible-light sensitization, charge-carrier generation and surface ROS formation. The coatings translate these mechanisms into practical antibacterial and pollutant-removal effects under typical indoor illumination levels, making them well suited for buildings where continuous passive decontamination can add value to existing hygiene and ventilation strategies.

A key element of this work is the integration of Safe-by-Design (SSbD) principles throughout the development chain. Measures include exposure-reducing production processes, engineering controls during nanoparticle synthesis, and design strategies such as silica encapsulation to minimize nanoparticle release from the final products. SSbD considerations also informed material scaling, application practices and the selection of coating architectures that maintain function while supporting safer handling and use across the product lifecycle.

Together, the visible-light-activated metal coatings and interior paints represent two distinct yet complementary approaches to incorporating antibacterial and air-purifying functionality into building materials and components. Their combined potential demonstrates how photocatalytic technologies, supported by SSbD methodologies, can contribute to healthier indoor environments through continuous, light-driven surface and air decontamination.

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Short CV:	

For more than 20 years, Dr. Alexandros Zoikis Karathanasis has been actively involved in the surface finishing sector involving nanotechnology solutions. He acquired his PhD from the School of Chemical Engineering at the National Technical University of Athens in the field of nano-composite electrodeposited coating in 2010, and since then, has participated in and coordinated multiple EC-funded research and industrial projects in the field of coatings utilizing the principles of green chemistry and environmental protection. He is the CEO of Creative Nano and an advisor/consultant to many technological companies, with a main expertise in the upscaling of lab-scale results to industrial processes. He has published over 40 scientific and technical papers as well as a patent in the nanotechnology field.