EPD OF DOPED NANOSTRUCTURED VITREOUS SILICA COATINGS: PROCESSING, ANTIMICROBIAL BIOACTIVITY AND APPLICATIONS

Guido Falk, Research Group of Structural and Functional Ceramics, Saarland University, D66123 Saarbruecken, Germany
g.falk@nanotech.uni-saarland.de

Resistant pathogens and their growing global circulation is a rapidly increasing threat that affects all areas of human life. This threat is further afflicted with a drastic lack of (new) effective drugs as well as insufficient preventive and diagnostic possibilities. Consequently, there is a need for a ceramic coating that has built–in protection against the growth and proliferation of resistant pathogens. However, existing technologies are somewhat limited in this regard. For example, the high temperatures used in ceramic firing processes typically preclude the use of organic antimicrobial agents.

Conventional inorganic silver-based antibacterial compounds (e.g., zeolite, amorphous glass, sol-gel) generally are too expensive for commercial use. Moreover, incorporation of silver-based antimicrobial agents into ceramic glazes routinely presents issues of clouding, crazing, discoloration, and other undesirable consequences to the glaze aesthetics. Zinc oxide is known as having antimicrobial characteristics and has been used in the preparation of ceramic glazing compositions. However, known ceramic glazing compositions that rely solely upon zinc oxide as an antimicrobial agent have not shown antimicrobial efficacy sufficient for control of microbial growth and proliferation on ceramic surfaces. Accordingly, there is a need for a low-cost ceramic coating that offers persistent built-in antimicrobial protection.

Here we show EPD, based on membrane templating, may answer these requests of realization of nano-topological design of glazings, while offering at the same time a wide library of available antimicrobial efficient nanomaterials, including silver, zinc oxide and titanium dioxide to be incorporated into the surficial glazing layers. The growth of nanostructered functional coatings takes place directly onto prefired ceramic bodies surface exposed in front of the EPD field. Cluster soft-assembling generates nanoporosity and, as consequence, coatings with nanoscaled pin structure and large specific surface, which are particularly suited for applications where interaction with pathogens in liquid solutions or gas-phase atmospheres has to be favoured.

Results on the integration of nanostructured coatings into devices with applicative purposes in consumer ceramic products and in sanitary ware products, will be reported. They include pathogen sensing, cell adhesion, and selective cell degradation, as examples of functions that may by added to devices by EPD coating of silicate ceramic consumer products.