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Nanoarchitectonics for polymer-ceramic hybrid coated ceramic tiles for antibacterial activity and wettability

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Abstract

In the present study, polymer-coated and Si_3N_4-modified glaze was developed to provide a synergetic effect of an antibacterial and superhydrophobic property on ceramic tile surface. The fact that the antibacterial activity of Si_3N_4 is not yet known in the tile industry and in many applications is unique aspect of the study. In addressing this issue, antibacterial effect was tested against gram-positive S. aureus and gram-negative P. aeruginosa. More significantly, the antibacterial and superhydrophobic surfaces were obtained firing at industrial kiln without changing the standard furnace regime for tile production. The superhydrophobic and antibacterial properties of the developed surfaces were determined by contact angle, surface energy, roughness, scanning electron microscopy, X-ray diffraction and antibacterial tests and the results compared with the commercial porcelain stoneware tiles. Superhydrophobic and antibacterial effect formation occurred due to micro-nano hybrid surface structure formed by Si_3N_4 crystals. The 155 ° water contact angle was reached on industrial tile surfaces. The Si_3N_4-modified surfaces resulted in a bacteria population reduction of over 99.97% and 99.11% for S. aureus and P. aeruginosa, respectively. It has found that the surface hydrophobicity is a clear determining factor for microbial growth and proliferation.