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Modulatory activity of TiO_2, CeO_2 and ZnO on human neutrophil degranulation

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Background: Nanoparticles (NPs) are used in a vast array of applications, including personal products (sunscreens, textiles, cosmetics, etc.), household commodities (e.g. components of paints, carpets, etc.) food and in medicine. Because the number of products containing NPs increased rapidly, it is clear that humans will be gradually ever more exposed to NPs. Therefore, the effect of NPs on human health needs to be determined. Recently, human neutrophils have been found to be targets to NP exposure. Knowing the importance of neutrophils in inflammation, investigating the ability of NPs to modulate neutrophil functions is an excellent way to evaluate potential nanotoxicity of a given NP. Degranulation is one of the most important functions exerted by neutrophils for the defense of an organism against an infection; it consists in a rapid release of potent degradation enzymes, several receptors involved in the recognition and ingestion of pathogens, etc. These molecules are localized in three different kinds of granules: azurophil, specific/gelatinase and secretory granules.

Objective: The objective of the present study was to determine if the three NPs, TiO_2, CeO_2, and ZnO can alter the degranulation process.

Methods: Neutrophils were isolated from healthy volunteers and incubated *in vitro* with 100 µg/ml of TiO_2, CeO_2, or ZnO NP. The concentration of 100 µg/ml was selected according to previous preliminary experiments. Degranulation was assessed by flow cytometry, by monitoring cell surface expression of marker for each granules (CD63, CD66b and CD35 for azurophil, specific/gelatinase and secretory granules, respectively). In addition, western blot experiments were conducted to identify proteins secreted from the granules into the extracellular milieu. Finally, zymography assay was used to determine enzymatic activity in the extracellular milieu allowing visualization of gelatine degradation by gelatinases contained in the specific/gelatinase granules.

Results: The cell surface expression of CD66b was significantly increased by CeO_2 and TiO_2 while the expression of CD63 and CD35 was not significantly altered. The protein expression of myeloperoxidase (azurophil granules) and matrix metallopeptidase 9 (MMP9 or gelatinase B) (specific/gelatinase granules) was significantly increased by the three NPs. The protein expression of albumin was significantly increased by CeO_2 and TiO_2 but, although its expression was increased by ZnO, this was not significant. Zymography revealed that the enzymatic activity in the supernatant of CeO_2 and TiO_2 induced neutrophils was significantly increased, but not ZnO.

Conclusion: We conclude that the three tested NPs can induce degranulation in human neutrophils. However, the cell surface expression of specific markers for each type of granules does not appear to be the best way for determining potential effect on degranulation, except for CD66b, since the results also correlate with the detection of the protein (gelatinase B) in the supernatants, as well as the gelatinase enzymatic activity detected by zymography.

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The growth and analysis of GaP anti-reflector for efficient Si-based solar cell

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The structural and reflectance properties of large gallium (Ga) droplet and GaP anti-reflector grown on n-silicon (100) for solar cell were presented. Self-assembly GaP anti-reflector structure was grown by droplet epitaxy (DE) method. The diameter, height and density of Ga droplets on silicon were investigated. The crystal structure of GaP anti-reflector was investigated as the Phosphor (P) flux injection. The growth mechanism was studied by the measurement of atomy force microscopy (AFM), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The reflectance results suggest the possibility of a novel method for anti-reflecting coating for Si-based solar cell. For GaP anti-reflector structure, reduction of reflectance for s-, p-polarization at 20° ~ 80°and approximately 50% reduction of reflectance at normal incidence was presented. The reflectance measurement was conducted by ultra violet infrared spectroscopy (UV-IR) and Ellipsometry. This results show that GaP anti-reflector is a good anti-reflector candidate for efficient Si-based solar cell.

Biography

Kyu Hyoek Yoen has completed his bachelor of chemical engineering degree at the age of 26 from Sungkyunkwan University. He came from Korea. He is a 4th grade master course student of University of Science & Technology. He is a student researcher in Korea Institute Science Technology. His proceeding paper was submitted to the Current Applied Physics and Material Research Board.

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