水中メカノ殺菌効果を発現する TiO_2 ナノピラーの合成と機能評価

（千葉工大院[1]・産総研[2]）○白坂 知也[1,2]・五十嵐 香[1]・宮崎 ゆかり[2]・根岸 信彰[2]
Mechano-Bactericidal Effect in Water Synthesis and Functional Evaluation of TiO_2 Nanopillars
([1]*Graduate School of Engineering, Chiba Institute of Technology*, [2]*National Institute of Advanced Industrial Science and Technology*) ○Tomoya Shirasaka,[1,2] Kaoru Igarashi,[1] Yukari Miyazaki,[2] Nobuaki Negishi[2]

Lack access to safely water is a global problem. Titanium dioxide photocatalyst, which is inexpensive, safe, and easy to maintain, has been proposed for drinking water treatment as one way to deal with this problem. However, photocatalyst has the disadvantage that is inactivated under low-illuminance conditions such as rainy and night. Therefore, we tried to investigate the possibility of supplementing the disadvantages by combining photocatalyst with mechano-bactericidal effect[1)] in water, which has not yet been investigated. In this study, we controlled the shape of the TiO_2 nanoneedle (nanopillar) on photocatalyst substrate and investigated the effect of the difference of their shape to the bactericidal performance.

The various shapes of TiO_2 nanoneedles were generated onto TiO_2 substrates (PSB-01) by hydrothermal synthesis using $TiCl_4$ in the range of 0.2 M to 4.0 M. Upright needles with respect to the substrate were formed from 0.2 M to 2.0 M, and multi-directional needles with respect to the substrate were formed from 2.4 M to 4.0 M of $TiCl_4$ concentration. The sterilization efficiency of these needles was investigated, and higher sterilization efficiency was obtained regardless of needle shape than the PSB-01.

Keywords : Water Purification; Photocatalyst; Mechano-bactericidal effect; Nanostructure

安全な水へのアクセスができない問題は国際的な問題である。解決の方法の１つとして、安全・安価かつ易メンテナンスな酸化チタン（TiO_2）光触媒による水処理が提案されている。しかし、光触媒は低照度時の活性低下が問題である。そこで、我々は検討例の少ない水中におけるメカノ殺菌効果[1)]を光触媒に組み合わせることで、光触媒殺菌効果の低照度時における補完が可能か否か検討した。本研究では、TiO_2 基材表面にナノニードルを合成し、形状の差による殺菌性能の違いの有無を観察した。

ナノニードルは 0.2 M から 4.0 M の濃度範囲の $TiCl_4$ を用いて TiO_2 基材(PSB-01)上に水熱合成した。0.2 M から 2.0 M までは基材に対して直立、2.4 M から 4.0 M までは基材上でランダムな針が成長した。これらの殺菌効率を測定したところ、全ての針形状においてPSB-01 よりも高い殺菌効果が得られた。

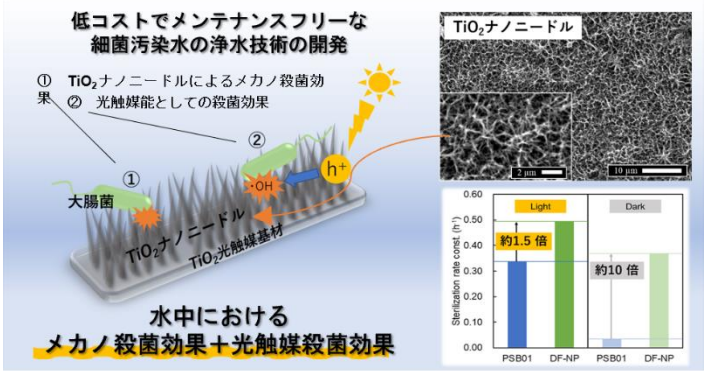

図 1 殺菌メカニズムの模式図と合成試料の SEM 像及び殺菌効率の比較

1) E. P. Ivanova, et al., *Small*, **2012**, *8*, 2489-2494.