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Spontaneous formation of highly intricate and symmetric silica nanostructures as analogue to biosilica morphogenesis

Jaeseok Yi[1], Sunsang Kwon[1] and Won Il Park[1]
[1]Hanyang University, Republic of Korea
[2]Sookmyung Women's University, Republic of Korea

Although lithographic patterning and manufacturing techniques have been significantly developed, the artificial fabricating of highly intricate silica nanostructures is hardly achieved by current technologies. In nature, the elaborate structures could be fabricated by biological processes such as diatom and sponge shell. Inspired by this biological fabrication, biomimetic approaches have been attempted to fabricate silica structures even at mild conditions with lower energy consumption. However, despite the considerable effort has been devoted toward biomimetic silification, the synthesis of highly complex silica structuresis still in its infancy, because of different release process of the constituents of biosilica. Here, we report the bioinspired fabrication of well-organized and symmetric silica nanostructured networks, involving phase separation and silicic acid polymerization processes, in analogy to the morphogenesis of diatom cell walls. Our approach exploits self-assembled silica spheres as a self-source of the silicic acids as well as scaffolds that, interplayed with droplets of ammonium hexafluorosilicate, direct the site-specific silification. Moreover, we have achieved multiple morphological evolutions with subtle changes in the process, which demonstrates exquisite levels of control over silica morphogenesis.

wipark@hanyang.ac.kr, jhvmnd@naver.com

Effect of graphene on photocatalysis of titanium dioxide thin films

Haroon Mahmood and Amir Habib
National University of Sciences and Technology, Pakistan

Graphene, having remarkable properties like high surface area, superior electronic and optical properties, has emerged as one of best constituent material for photovoltaic devices. The main goal of this research is to investigate the effect of graphene amount on photocatalysis of titania thin films. Graphene was synthesized by modified Hummer's method and subsequently reduced before using for film fabrication. Titania sol was prepared which was mixed with varying amount of reduced graphene. Multilayer thin films were deposited by dip-coating on glass and ITO substrates. Resulting composite films were characterized by SEM for morphological evolution of mesoporous titania thin films and uniform dispersion of graphene, XRD for phase analysis revealing high amount of anatase and UV-Vis spectrophotometer for studying optical properties. An increase of photocatalytic activity was found with increasing graphene amount and reduction of band gap up to 2.9 eV was obtained.

Biography

Haroon Mahmood has completed his Master's degree in Materials and Surface Engineering from National University of Sciences and Technology, Islamabad - Pakistan. At present he is working on energy materials and fabrication of solar cells for next generation photovoltaic devices.

haroon88@gmail.com