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Aero-Materials Based on Wide-Band-Gap Semiconductor Compounds for Multifunctional Applications: A Review

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Abstract

Over the last decades, controlling 3D micro-nano-architectures of semiconductor materials has been used to bring to light new characteristics and even new phenomena. This approach is especially promising when applied to the design of hybrid micro-nano-architectures. The aim of this paper is to review the research efforts undertaken last years to develop novel hybrid three-dimensional micro-nano-architectures based on wide-band-gap binary compounds for multifunctional applications. Special attention will be paid to 3D micro-nano-architectures based on GaN, but results of investigation of architectures based on Ga_2O_3, ZnS, ZnO will be presented as well. Self-interaction of aero-tetrapods of GaN on water surface leads to the formation of elastic membranes that exhibit high degree of porosity with impressive cargo capabilities. Wrapping liquid droplets into aero-GaN we demonstrate the formation of liquid marbles, that show unique characteristics like self-propulsion on water surface at record velocities, pulsed rotations and pendulum-like oscillations of liquid marbles. Higher photocatalytic response was achieved by functionalizing aero-nanomaterials with noble metal nanoparticles. Besides microfluidic applications, aero-GaN proves to be highly efficient in shielding electromagnetic fields in the GHz and THz region, while aero-Ga_2O_3 is completely transparent in the same spectral region.

Keywords: aerogalnite, gallium nitride, liquid marbles, hybrid three-dimensional micro-nano-architectures, 3D micro-nano-architectures

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