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Nature-inspired novel nanomaterials for multifunctional applications

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The modern market requires new multifunctional materials which should be compatible with both electronics and living organisms. In this presentation, we report on novel bio-inspired hybrid nanomaterials –the so called aero-materials based on semiconductor compounds [1-4]. In particular, we report on a novel bio-inspired 3D nanoarchitecture of GaN, called aero-GaN or Aerogalnite, which represents the first artificial material exhibiting dual hydrophobic-hydrophilic behaviour (see [1] and https://physicsworld.com/a/hydrophobic-or-hydrophilic-aero-gallium-nitride-is-both/) and has similar properties to a biological cell membrane. The 3D nanoarchitecture is based on GaN micro-tubular structures with nanoscopic thin walls, the inner surface being covered by an ultrathin film of ZnO. The micro-tubular structures are shown to self-organize when interacting with water, forming self-healing waterproof rafts with impressive cargo capabilities. The physical properties of aero-GaN will be presented in the context of prospects for microfluidic and biomedical applications [5]. Along with this, the novel material is shown to exhibit shielding capabilities against electromagnetic radiation in both the X-band (8-12 GHz) and Terahertz regions [6,7]. The shielding effectiveness in the frequency range from 0.25 to 1.37 THz exceeds 40 dB, thus placing aero-GaN among the best Terahertz shields known today [7].

Results of characterization of other aero-materials including aero-ZnS and aero-Ga2O3 are presented and possibilities of their applications in various fields are elucidated. The support from the European Commission under the Grant #810652 “NanoMedTwin” is acknowledged.

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