



Contribution ID: 275 Contribution code: PT-09

Type: Plenary talk

Nature-inspired novel nanomaterials for multifunctional applications

Monday, 29 August 2022 12:15 (45 minutes)

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.

References

1. I. Tiginyanu, T. Braniste, D. Smazna, M. Deng, F. Schütt, A. Schuchardt, M. A. Stevens-Kalceff, S. Raevschi, L. Kienle, N. Pugno, Y. K. Mishra, R. Adelung. Self-organized and self-propelled aero-GaN with dual hydrophilic-hydrophobic behavior. *Nano Energy*, Vol. 56, 759-769 (2019).
2. Irina Plesco, Tudor Braniste, Niklas Wolff, Leonid Gorceac, Viola Duppel, Boris Cinic, Yogendra Kumar Mishra, Andrei Sarua, Rainer Adelung, Lorenz Kienle, Ion Tiginyanu Aero-ZnS architectures with dual hydrophilic-hydrophobic properties for microfluidic applications. *AIP Materials*, Vol. 8, 061105 (2020).
3. Irina Plesco, Vladimir Ciobanu, Tudor Braniste, Veaceslav Ursaki, Florian Rasch, Andrei Sarua, Simion Raevschi, Rainer Adelung, Joydeep Dutta, Ion Tiginyanu. Highly-Porous and Ultra-Lightweight Aero-Ga₂O₃: Enhancement of Photocatalytic Activity by Noble Metals. *Materials*, Vol. 14, 1985 (2021).
4. Tudor Braniste, Mircea Dragoman, Sergey Zhukov, Martino Aldrigo, Vladimir Ciobanu, Sergiu Iordanescu, Liudmila Alyabyeva, Francesco Fumagalli, Giacomo Ceccone, Fabian Schütt, Rainer Adelung, Pascal Colpo, Boris Gorshunov and Ion Tiginyanu. Aero-Ga₂O₃ nanomaterial electromagnetically transparent from microwaves to terahertz for the internet of things applications. *Nanomaterials*, Vol. 10, 1047 (2020).
5. Tudor Braniste, Vladimir Ciobanu, Fabian Schütt, Hidenori Mimura, Simion Raevschi, Rainer Adelung, Nicola Pugno, Ion Tiginyanu. Self-propelled aero-GaN based liquid marbles exhibiting pulsed rotation on the water surface. *Materials*, Vol. 14, 5086 (2021).
6. M. Dragoman, T. Braniste, S. Iordanescu, M. Aldrigo, S. Raevschi, S. Shree, R. Adelung, I. Tiginyanu. Electromagnetic interference shielding in X-band with aero-GaN. *Nanotechnology*, Vol. 30, 34LT01 (2019).
7. T. Braniste, S. Zhukov, M. Dragoman, L. Alyabyeva, V. Ciobanu, M. Aldrigo, D. Dragoman, S. Iordanescu, S. Shree, S. Raevschi, R. Adelung, B. Gorshunov, I. Tiginyanu. Terahertz shielding properties of aero-GaN. *Semicond. Sci. Technol.*, Vol. 34, 12LT02 (2019).

Primary author: TIGINYANU, Ion (Technical University of Moldova; Academy of Sciences of Moldova)

Presenter: TIGINYANU, Ion (Technical University of Moldova; Academy of Sciences of Moldova)

Session Classification: Plenary Talks

Track Classification: Scientific Sections: S06 Condensed Matter Physics and Statistical Physics