Novel advanced laser-synthesized nanomaterials for healthcare and energy: design, fabrication and applications

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The presentation will overview our on-going activities on laser ablative synthesis of novel biocompatible colloidal nanomaterials and their testing in biomedical tasks. Our original approach is based on ultra-short (fs) laser ablation from a solid target [1,2] or already formed water-suspended colloids [3] to fabricate "bare" (ligand-free) nanoparticles (NPs) with well-controlled size characteristics, as well as coating of nanomaterials by functional molecules (dextran, PEG etc.) during the ablation process or afterwards [4]. The presentation will describe recently developed approaches to achieve appropriate characteristics of several promising nanostructures, including plasmonic Au [1,3,4], TiN [5], ZrN [6], HfN [7] nanoparticles, Bi nanoparticles [8], B nanoparticles [9], semiconductor Si [10] and Ge [11] nanoparticles, van der Waals nanostructures [12,13], and composite core-satellite (Si@Au [14], $Fe3O_4$@Au [15,16]) nanostructures. The presentation will also overview our results on biological assessment of some laser-synthesized nanomaterials [16-18], as well as highlight some biomedical applications of laser-synthesized nanomaterials, including their use as contrast agents in SERS bioidentification [19], non-linear optical [20], photoacoustic [21] and MRI [16] bioimaging, sensitizers of photothermal therapy [5-7, 11, 12, 16], vectors of radionuclides in nuclear medicine [22]. Finally, the presentation will overview some energy applications of laser-synthesized nanomaterials, including their use as electrocatalysts of glucose oxidation [23,24] and thermal nanofluids for solar energy conservation [25].

Références

[1] A. V. Kabashin, M. Meunier, J. Appl. Phys. **94**, 7941 (2003).
[2] A. V. Kabashin, M. Meunier, J. Phys.: Conf. Series, **59**, 354 (2006).
[3] S. Besner, A. V. Kabashin, M. Meunier, Appl. Phys. Lett, **89**, 233121 (2006).
[4] S. Besner, A. V. Kabashin, F. Winnik, M. Meunier, Appl. Phys. A. **93**, 955 (2008).
[5] A. A. Popov, et al, Sci. Rep. **9**, 1194 (2019).
[6] A. I. Pastukhov et al, ACS Appl. Nano Mater. **7**, 18737 (2024)
[7] A. I. Pastukhov et al, Nanoscale, **16**, 17893 (2024).
[8] J. C. Bulmahn, et al, Nanomaterials, **10**, 1463 (2020).
[9] A. I. Pastukhov, et al, Sci. Rep. **12**, 9129 (2022).
[10] A. V. Kabashin, et al., ACS Nano **13**, 9841 (2019).
[11] I. B. Belyaev, et al. Advanced Science, **11**, 2307060 (2024).
[12] G. I. Tselikov et al, PNAS, **119**, e2208830119 (2022)
[13] G. I. Tselikov et al, ACS Nano, **19**, 25, 22820 (2025)
[14] A. Al-Kattan, et al., Nanomaterials **11**, 592 (2021).
[15] A. A. Popov, et al., Nanomaterials **12**, 649 (2022).
[16] O. Yu. Griaznova, et al, Pharmaceutics **14**, 994 (2022).
[17] I. V. Zelepukin, et al, Mater. Sci. Eng. C **120**, 111717 (2021).
[18] I. V. Zelepukin, et al, Chem. Eng. Journal **430**, 132860 (2022).
[19] M. Kögler, et al, J. Biophoton. **11**, e201700225 (2018).
[20] A. Kharin, et al, Adv. Opt. Mater. **7**, 1801728 (2019).
[21] A. Das, et al, Appl. Phys. Lett. **121**, 083701 (2022).
[22] V. M. Petriev, et al., Sci. Rep. **9**, 2017 (2019).
[23] S. Hebie, et al, ACS Catalysis **5**, 6489 (2015).
[24] Y. Holade, et al, Catal. Sci. Tech. **10**, 7955 (2020).
[25] S. Farooq, et al, Solar Energy Materials and Solar Cells, **252**, 112203 (2023).

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