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Metallic nanoparticles in air plasma activated water

B. Tarabová[1], M. Medvidov[2], K. Kučerová[1], D. Rak[3], M. Sedlák[3], M. Janda[1], M. Hammer[4], Z. Machala[1], K. Hensel[1]

[1]Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava 84248, Slovakia
[2]ZIK HIKE, University of Greifswald, Greifswald 17489, Germany
[3]Institute of Experimental Physics, Slovak Academy of Sciences, Košice 04001, Slovakia
[4]Centre for Innovation Competence "plasmatis", INP Greifswald e.V., Greifswald 17489, Germany
e-mail: tarabova@fmph.uniba.sk

Air plasma activated water (PAW) and liquids are nowadays of the great interest because of their bactericidal or therapeutic properties. These are typically given by the synergistic effects of the plasma action and induced chemical changes (via formation of reactive oxygen and nitrogen species). Beside the plasma agents and induced aqueous chemistry, metallic nanoparticles (NP) sputtered from electrodes may enhance the chemical effects and contribute to the bactericidal effect of PAW [1-2]. The objective of this work was to detect and examine possible NP in the PAW prepared by the DC-driven transient spark discharge in direct contact with liquid, either in the water spray (WS) or the water electrode (WE) system [3]. In the WS system, the stainless steel hollow needle high voltage electrode enabled the water to be electrosprayed directly through the active zone of discharge. In the WE system, the water was repetitively circulated on the grounded electrode through the discharge zone. We used the scanning electron microscopy (SEM) to examine the tip of the needle and the presence of particles in the PAW; the elemental composition was examined by the electron dispersive X-ray spectroscopy (EDS); the volume size distribution of particles by the dynamic and static laser light scattering (DLS/SLS) and nanoparticle tracking analysis (NTA).

SEM analysis showed morphological changes of the plasma treated needle. The needle lost its sharpness and specific patterns of "melted areas" were observed on its surface. SEM observation of the treated DI water showed the presence of particles with the size from nm to several μm. More detailed analysis of particles by DLS, SLS, and NTA showed a wide distribution of particles mainly below 500 nm (Fig. 1). The EDS analysis confirmed that the elemental composition of the NP was identical with the needle composition (Fe, Cr, Ni, O).

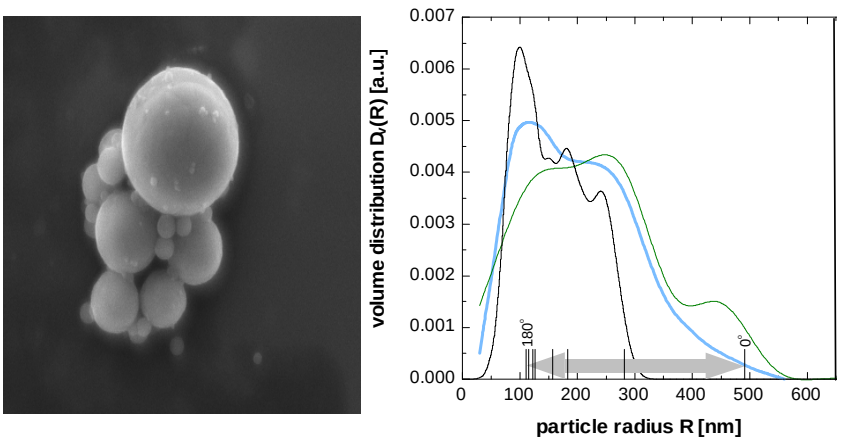

Fig. 1 SEM picture (10,000x magnification) of metallic particles in the PAW (left). Volume size distribution of NP analyzed by various methods (right): black (NTA), green (SLS), blue (optimal combination of NTA and SLS). Vertical lines show DLS data for various scattering angles.

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References

[1] J.A. Lemire, J.J. Harrison, R.J.Turner, *Nature Reviews Microbiol.*, **11**, 371 (2013).
[2] S. Shamaila, H. Wali, R. Sharif, *Appl. Phys. Let.*, **103**, 153701 (2013).
[3] K. Hensel, K. Kučerová, B. Tarabová et al., *Biointerphases*, **10**, 029515 (2015).