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# Nanostructured surfaces for on-plate processing of biological samples in MALDI mass spectrometry

**E. Barborini**
Tethis SpA, Italy

Matrix-assisted laser desorption/ionization mass spectrometry (MALDIMS) is a powerful analytical tool endowed with the capability to analyze in short time several classes of biomolecules (e.g. peptides, proteins, nucleic acids) as well as micro-organisms (e.g. bacteria), up to whole histological sections. However, MALDI-MS effectiveness may be hampered by the complexity of the sample itself or by the presence of contaminants. This requires a many-steps pre-analysis processing of the samples, which is carried out in-vial. Nanostructured surfaces can be exploited to transfer sample processing (e.g. secondary cleaning, enzymatic cleavage) from vials directly to the MALDI plate. Here we show the use of Cluster Beam Deposition [1,2] to deposit patterned nanostructured films, made of ultrafine $TiO_2$ nanoparticles (top image), onto suitable substrates for MALDI-MS. Material nanoporosity (due to nanoparticle soft-assembling) and bio-affinity play a synergic role in sample capturing. Super-hydrophilicity induced in $TiO_2$ by UV irradiation [3] ensures uniform spreading in the case of liquid samples as well as optimal adhesion in the case of histological sections. Hydrophobic barrier at the border of the super-hydrophilic nanostructured areas acts as an effective confinement structure for droplets (bottom image), allowing reliable on-plate sample processing. In comparison with standard in-vial approach, on-plate processing avoids the loss of sample fractions due to cleaning or to the sticking on vials plastic surfaces, and improves the management of scanty samples in general. Regarding histological samples, the nanostructured film improves tissue adhesion and avoids detachment, tearing and shrinking, during processing (e.g. dehydration, delipidation, fixation). Improved adhesion can also benefit pharmaco-kinetic studies, where any tissue treatment is a-priori excluded [4]. The use of nanostructured films and surface-engineering concepts for the development of advanced plates in MALDI-MS may contribute to further fuel the spreading of this powerful analytical technique in clinical proteomic as well as biomedical and healthcare areas in general, with the ultimate benefit for patients.

## Biography

Emanuele Barborini received the PhD in Physics from the University of Milan in 2000. In 2004 he was co-founder of Tethis, a Nanotech-Biotech SME born as Spin-off of the University of Milan. Since 2007 he serves as Head of Applicative Research and R&D Special Projects Manager at Tethis, where he manages Applied Research and related Technology Transfer projects. His main achievements regard: atomic clusters and nanomaterials production methods, chemoresistive micro-sensing, nanomaterial-based devices for oncology and proteomics. In 2015 he was Visiting Scientist at the University of Helsinki, where he coordinated the research on the use of nanostructured surfaces in MALDI mass spectrometry. Dr. Barborini is author of 97 scientific publications and inventor of 10 national (Italy) and international (EU, USA) patents. He has h-index 26 and 2325 citations (Scopus, July 2018). In 2017 he has been awarded the "Abilitazione Scientifica Nazionale 02/B1 Prima Fascia".

emanuele.barborini@tethis-lab.com

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