

Smart biointerfaces for cancer biomarkers analysis in extracellular fluids

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The research activities in the area of bio interfaces and surfaces, connecting material science and biology, are continuously growing due to their applications in biology and medicine. The isolation and analysis of low abundant biomarkers, such as circulating miRNAs, ctDNA, CTCs cells or small proteins, using solid surfaces with increased resolution, sensitivity and specificity represent a revolution for diverse clinical features: early diagnosis, choice of personalized treatment, follow-up of the treatment in real time and the detection of minimal residual disease and malignant neoplasms. The methods for the introduction of biological functionalities on inorganic/organic materials and tailoring their surface properties to improve their biocompatibility, constitutes a core activity on which the successful development of the next generation of biological and medical devices is based. Here the work of design, fabrication, testing and validation of a new technological platform, which starting from a little amount of blood can purify components such as miRNAs and exosomes will be presented. Several materials were explored by modifying both the surface charge and morphology. An optimal surface for miRNAs purification from biological samples (human plasma and sera, cell lysates and tissue homogenates) was successfully set up and implemented on a polymeric Lab-on-a-chip. In this case, the purification and reverse transcription of miRNAs occurs in the same microdevice since the purified miRNAs are directly available for reverse transcription without any release step. The cDNA obtained is completely compatible with the most used miRNA detection method, i.e. quantitative real-time PCR. Bio-functional surfaces for specific classes of miRNAs (AGO2-bound miRNAs, exosomes-loaded miRNAs) were also investigated with promising results, starting from the immunocapture of specific proteins. In addition, preliminary data of the development of the extracellular vesicles prefiltering and separation units will be presented.