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Advances in etched ion-track polymer membranes for environmental and microelectronic applications

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Etched ion-tracks membranes are well-known and commercially available membranes for filtration and, in the past decades, have attracted a huge interest for applications in life sciences. More recently, since these membranes serve as template for nanowires or nanotubes fabrication, applications in microelectronics (eg. MRAM for computers) have also been widely investigated. Control over the swift heavy-ion irradiation and subsequent etching condition enables the production of multiple or single channels of high aspect ratio. Playing on polymers chemical structure, crystallinity and track-etching strategies, channels of predefined sizes and geometries can be tuned such as cylindrical, conical or oblade-shaped channels, crossed-channels … Track-etching technique presents the advantage to be industrially scalable. Among other exemples, we will discuss how a large area fabrication of self-standing nanoporous graphene-on-PMMA substrate, interesting candidates for field-emission transistors, can simply be achieved. Ten years ago, we have shown that, after a relatively short etching time, some track-etched nanoporous polymer membranes exhibited an EPR signal witnessing the presence of remaining radicals. These radicals, results of ion-matter interactions from previous irradiation, have been found reactive enough to initiate the radiografting of vinyl monomers. The grafted polymer chains are specifically localized on and all along the nanopores walls. This discovery has opened our applications field from polymer electrolyte membranes for fuel cells to the development of sensors of pollutants in waters. In this talk, we will present our very recent achievements on etched ion-track polymer membranes for sensor applications in environment and microelectronics. The key of success is the use of a peculiar polymer, the poly(vinylidene difluoride) (PVDF). PVDF is a biocompatible and semi-cristalline polymer. Depending its crystillinity phase, it can also be piezoelectric. We will present how we have exploiting these properties for sensor applications.

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