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HIGHLIGHTS

Polymer nanofibers

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Nanofibers (NF) possess small diameters in sub-micrometer range with its length up to meter level, and NFs are considered as one-dimensional nanomaterials. High specific surface area and large aspect ratio of NF are attractive on developing analytical application [1, 2]. In this highlight, analytical utilizations of polymer nanofibers are focused. Inorganic nanofibers [3] or carbon nanofibers [4] will be introduced at another opportunity. Polymer nanofibers have been fabricated by mechanical drawing, template synthesis, phase separation, melt blowing, and electrospinning. Among the fabrication methods, electrospinning is one of the promising methods to prepare functional nanofiber. Nanofibers, thus, fabricated have analytically been utilized as the separation/concentration matrices and detection media.

Qi et al. prepared nanofibers mat (NFsM) with polyacrylonitrile by electrospinning [5]. The NFsM was immersed in pyrrole monomer solution, and the pyrrole was polymerized with $FeCl_3$. The polypyrrole-functionalized NFsM was used for the solid-phase extraction of cationic dyes in waste water prior to the HPLC–DAD determination [5]. Wang et al. fabricated chitosan nanofibers, and the surface of the nanofibers was functionalized with hyaluronic acid to improve the biocompatibility and to catch circulating tumor cells [6]. Ueta et al. prepared polyethylene terephthalate nanofiber sheet by a CO_2 laser supersonic drawing for the preconcentration unit of HPLC analyses [7]. The preconcentration unit was utilized for the analysis of dibutyl phthalate and di(2-ethylhexyl)phthalate [7], as well as five water-soluble polycyclic aromatic hydrocarbons [8]. Deng et al. prepared four types of nanofiber mat by electrospinning for the trapping of trace heavy metals in atmospheric particles [9]. The metal ions were eluted with acetate buffer (pH 4.5), and the eluted metal ions were quantified by ICP-MS. Dithizone-supported polystyrene showed best trapping performance against As, Cd, Hg, and Pb [9]. Yamamoto et al. fabricated nylon monofilament mold in a microchannel of microchip electrophoresis, and the nylon monofilament mold was utilized as a size-exclusion separation of isomaltooligosaccharide [10]. Nanofibers comprising polystyrene and zinc acetate was fabricated by Wu et al. and the nanofiber was used for the solid-phase extraction of salivary histidine after diazotization of histidine; the histidine derivative was eluted and histidine was quantified by HPLC–DAD [11]. Soft nanofibrous oligopeptide hydrogels with chirality were prepared by Yoshitomi et al. for the encapsulation of stem cells [12]. It was found that the mRNA level of the *d*-gel was maintained for 4 weeks, while the level significantly decreased in *l*-gel. The cell culture was maintained in the *d*-gel.

Polymer nanofibers have also been utilized as detection media. A nanofiber mesh prepared by Hersey et al. was subjected to the immunosorbent assays [13]. The nanofiber mesh was prepared with high-molecular-weight poly(norbornene) derivatives, and porous there-dimensional nanofiber meshes worked well for the binding of immunoglobulin G through biotin-streptavidin interactions. Mudabuka et al. prepared poly(vinylbenzyl chloride) nanofibers, and the nanofiber sheet was functionalized with tris-(2,2'-pyridylimidazole) iron(III) complex [14]. When ascorbic acid was added to the nanofiber sheet, the iron complex was reduced and red color was developed. Ascorbic acid was determined by eyeball detection. Cellulose acetate nanofiber mats modified with 2-(5-bromo-2-pyridylazo)-5-(diethylamino) phenol were prepared by Hu et al., and the nanofiber mat was used for the visual recognition of uranyl ion [15]. Murase et al. installed cellulose nanofiber modules on a μPAD for the inhibition assay of an enzyme [16]. The nanofiber modules contained acetylcholinesterase (AChE) as an enzyme and indoyl acetate (IDA) as a detection reagent, respectively. A

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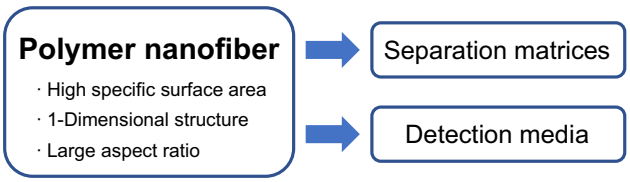
water flow propeled IDA to the AChE module, and IDA was hydrolyzed with AChE to form colored indigo. When the AChE module contained any inhibitor such as malathion, the enzyme reaction was inhibited and the color was not developed. Prapaporn et al. developed another format of μPAD with nanocellulose films [17]. The film was placed onto the sampling spot, and solutions of silver nanoparticles (AgNP) and glucose oxidase were added and dried at the detection zone. When glucose in the sampling spot migrated to the detection zone by capillary action, hydrogen peroxide was formed with glucose oxidase and colored AgNP is oxidized to form colorless AgNP. The glucose was determined by the length of the colorless zone. Bai et al. prepared a polymer nanofiber film containing europium complex of 1-dimensional chain structure [18]. When Fe^{3+} solution was added to the film, red emission from Eu complex disappeared and the film was used for the Fe^{3+} detection. Polymer nanofibers are, thus, very useful as separation/concentration matrices and detection media.



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