Sensors & Diagnostics



EDITORIAL

View Article Online
View Journal | View Issue



Cite this: Sens. Diagn., 2024, 3, 1767

Introduction to Supramolecular Sensors: From Molecules to Materials

Sankarasekaran Shanmugaraju, 🕩 ** Robert B. P. Elmes 🕩 ** and Valeria Amendola 🕩 *c

DOI: 10.1039/d4sd90034k

rsc.li/sensors

This themed collection highlights the ongoing advancements in supramolecular sensor chemistry, a research area that continues to attract significant interest. Over the past few decades, substantial progress has been made in the rational design of chemosensors for the detection and quantification of a wide range of critical analytes, including anions, cations, toxic chemicals, hazardous substances, and biomolecules. In their perspective article (https://doi.org/10.1039/D4SD00022F),

Wynne and Elmes highlighted the supramolecular sensing and therapeutic applications of modified synthetic peptides. Synthetic peptides can be be highly tuned to selective and responsive sensor systems for specifically detecting target analytes with improved sensing properties. Given structural diversity, chemical versatility, and tunable functional properties, synthetic peptides have been well-adapted their supramolecular sensing platforms.

Phosgene is a highly toxic and hazardous chemical warfare agent that poses a severe threat to human health. Consequently, developing effective chemical sensors for the trace detection and identification of phosgene is crucial to ensure public safety. In their tutorial review article (https://doi.org/10.1039/ D4SD00048J), Gunnlaugsson and the Shanmugaraju group provided comprehensive overview of reactivitybased fluorescent chemosensors for selective sensing of phosgene. Building on this, the article offers an in-depth summary of the latest advancements in amino-1,8-naphthalimide-based small-molecule fluorescent sensors for the selective detection of phosgene.

Heavy-metal contamination of the environment is a contemporary issue of modern life. Among the different heavymetal ions, Pb(II) and Ag(I) as particularly recognized contaminants, causing environmental damage and posing significant threats to living organisms. Therefore, the design of an effective colorimetric and fluorescence chemosensor monitoring the concentration of these heavy-metal ions is essential. response this need, numerous fluorescent sensors incorporating various fluorescence moieties have been developed and successfully used for sensing applications. In their critical review article (https://doi.org/10.1039/ D3SD00289F), Watkinson and coworkers showcased a wide array of pyrene-containing small-molecule chemosensors utilized for the colorimetric and fluorescence-based

detection of Pb(II) and Ag(I) ions. They provided a detailed account of various design strategies employed in sensor development and explored structural influence the aspects sensitivity of pyrene sensors. The design and development of fluorescent sensors biologically relevant detecting analytes stimulates significant research turn-on interest. particular, fluorescent sensor designs enhanced photophysical properties that are particularly beneficial for biological ion detection. Due to their tunable and functions, structure ease synthesis, biocompatibility, and high photostability, Schiff-base-containing fluorescent chemosensors have long been extensively studied for their applications in sensor chemistry. In their critical review article (https://doi. org/10.1039/D3SD00110E), Swamy and co-workers described a variety of Schiffbase-based 'turn-on' fluorescent probes for sensing biologically important metal cations. In addition to discussing solution-state fluorescence sensing, their work provides in-depth exploration of the application of Schiffbase sensors in cellular offering insights into the specific localization of fluorescent probes within cellular organelles.

Hydrogels are polymeric soft materials that have attracted significant research attention due to their structural diversity and versatile applications, including biosensing and

^a Department of Chemistry, Indian Institute of Technology Palakkad, Palakkad-678557, Kerala, India. E-mail: shanmugam@iitpkd.ac.in

^b Department of Chemistry, Maynooth University, National University of Ireland, Maynooth, Co. Kildare, Ireland. E-mail: robert.elmes@mu.ie

^cDepartment of Chemistry, University of Pavia, Viale Torquato Taramelli 12, 27100 Pavia, Italy. E-mail: valeria.amendola@unipv.it

diagnostic bioimaging. A key advantage of hydrogels is that their structure and functional properties can be tailored to mimic the biological functions of biomolecules, thereby replicating their molecular interactions. This adaptability hydrogels particularly has made intriguing for use in 3D immunoassays, an area that has become a major focus of research. Hydrogels are employed as matrices to encapsulate biomolecules under native-like conditions. Bergamaschi and Gori's team presented (https://doi.org/10.1039/ D3SD00313B) proof-of-concept а demonstration of a composite Aga-Q3 hydrogel microarray for entrapment of extracellular vesicles within the 3D environment. Designing effective sensors for chemical-explosive detection is important for national security, civilian safety, and protecting the environment. In their article (https:// doi.org/10.1039/D4SD00151F),

Editorial

Shanmugaraju and Nanjan reported the synthesis and fluorescence sensing properties of a new 2'-benzyloxy flavone towards picric acid. In addition to its efficient detection of picric acid, 2'-benzyloxy flavone has also demonstrated differential fluorescence sensing responses to pH.

Inspired by natural photosynthesis,

various artificial light-harvesting systems based on different chromophores have been designed and employed in a range of applications. Xiao and co-workers (https://doi.org/10.1039/D3SD00297G) developed a Schiff base containing a tripodal sensor system featuring an aggregation-induced emission (AIE)active tetraphenylethylene luminogen, which exhibited typical AIE behaviour in a binary solvent system. Additionally, they developed a novel functional nanoparticle system by integrating this sensor with naphthalene diimide, which functions as an energy acceptor. The fluorescence sensing and light-harvesting properties of these newly designed nanoparticles were further elaborated, revealing their potential for advanced

applications. Finally, in their work (https://doi.org/10.1039/D3SD00188A), Gupta and co-workers described the synthesis and luminescence sensing properties of an alkyne-functionalized Zn(II) metal-organic framework (MOF) for ultrafast detection of Cu(I) and Pd(II) metal ions in aqueous medium.

This themed collection brings together some of the most significant contributions from leading experts in the field, offering a thorough overview the current landscape supramolecular sensor chemistry. The articles featured here not only highlight approaches the innovative techniques propelling this field forward, but also provide valuable insights and inspiration for future research. We are confident that readers will find this collection both informative and thought-provoking, sparking further advancements in the development of sophisticated sensor systems for the detection and monitoring of critical analytes.