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Fluorescent probes for therapeutic gas

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As a newly burgeoning field, gas therapy is attracting increasing attention and the development of bioprobes for detecting therapeutic gas molecules represents a vital challenge. In the first issue of *Chemical Synthesis*, Prof. Qianjun He and his co-workers reviewed fluorescent probes for gas detection and their applications in gas therapy. They connected the structures and properties of the probes with their functions in support of their design, thereby helping readers in the fields of gas biomedicine, molecular imaging, synthetic chemistry, theranostics, and so on.

Fluorescence-based imaging technologies have become common tools in the life sciences[1] and gas medicine, which represents a new approach to disease treatment, where gas molecules, such as NO, CO and H_2, exhibit specific therapeutic effects for many diseases[2]. However, the therapeutic effects and biological roles of these gases highly depend on the site, concentration and duration time of the treatment[3]. Therefore, it is of significance to monitor their concentration and biodistribution *in vivo*, but this remains challenging, even though a large number of studies have realized targeted delivery and the controlled release of gas molecules. Thus, probes that can virtualize gas molecules are essential for studying and understanding the effects and mechanisms of gas therapy.

In the review, Gong *et al.*[4] briefly introduced the structural characteristics of typical fluorophores and then summarized the gas probes based on them. In addition to their basic photophysical properties, the authors also provided information regarding their detection mechanisms. Furthermore, the advantages and disadvantages of gas detection strategies that could play a certain guiding role in the subsequent design of

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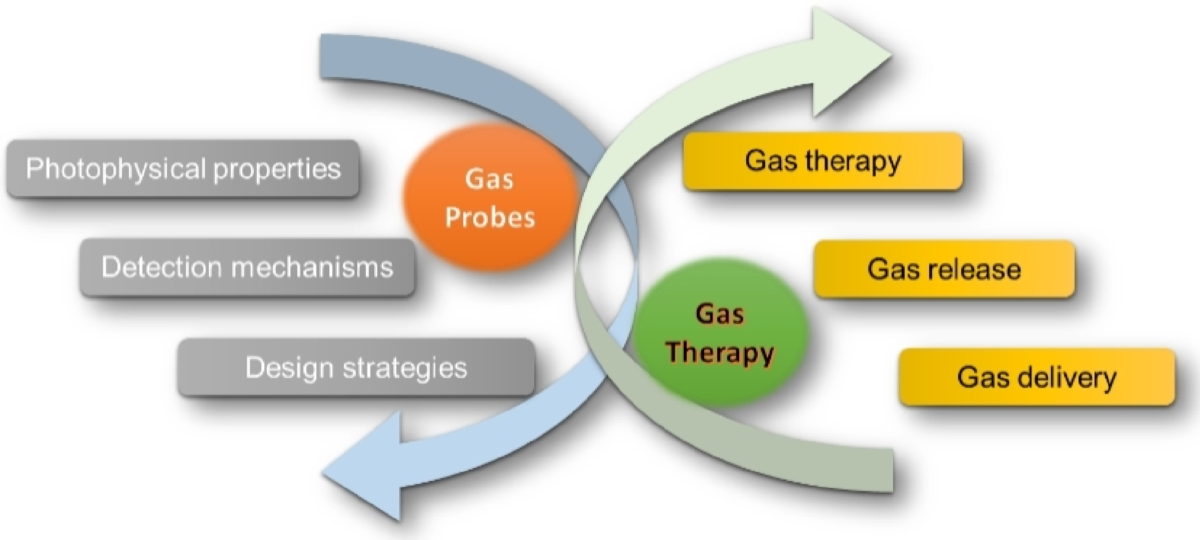

Figure 1. Gas probes and their applications in gas therapy.

advanced gas probes were also discussed [Figure 1].

Gong *et al.*[4] then discussed the applications of these probes. Gas therapy was initially realized by direct inhalation[5] or drinking gas-rich water, but to achieve a precise treatment, nanomedicines were developed[6]. The typical gas therapeutic process based on nanomedicine includes three stages: gas delivery, gas release and gas therapy [Figure 1]. In addition, with probes, the transportation and accumulation of gas carriers can be monitored, the gas release performance of nanomedicines can be evaluated and the gas-induced therapeutic effect could be determined. Therefore, with the help of probes, researchers can discover the shortcomings of nanomedicine and then make targeted improvements.

In the final section of their review, Gong *et al.*[4] summarized the currently used fluorophores and imaging technologies, as well as their shortcomings in the rapid development of gas therapy. As discussed, more stable and reliable gas detection probes need to be developed and the fluorescence techniques suitable for gas therapy should not be limited to ordinary confocal or two-photon fluorescence imaging[7]. More intelligent probes[8] and imaging techniques[9] are also required for a deeper understanding of the mechanisms of gas therapy.

In summary, the authors provided readers with an overview of the probes commonly used in gas therapy and their working mechanisms. Furthermore, detailed descriptions of the different roles in gas therapy were also included. This information provides invaluable insights and guidelines for the design of gas probes.

DECLARATIONS

Authors' contributions

The author contributed solely to the article.

Availability of data and materials

Not applicable.

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Conflicts of interest

The author declared that there are no conflicts of interest.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

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