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Amazing circularly polarized luminescence in inorganic materials

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Circularly polarized luminescence (CPL) is an amazing optical event specifically arising from chiral luminescent materials, which preferably emit either left-handed or right-handed circularly polarized light. CPL-active materials will find broad applications in many areas such as laser sources, 3D display, anti-counterfeiting, and bioimaging^[1-3]. In recent years, the development of CPL-active materials has become an active interdisciplinary topic across the fields of chirality and optics^[4]. Chirality is one prerequisite for CPL, and most CPL-active materials are traditionally constructed by using organic matter^[5], partially due to the long history of chirality research in organic chemistry. Nevertheless, chirality is not limited to organic substances but is also found in natural and synthetic inorganic matter. Especially, great advances have been achieved on sophisticated synthesis strategies of chiral inorganic materials in the past decade^[6]. As a result, the design of CPL-active systems using inorganic substances has gained increasing attention, which is significant to expand the scope of CPL-active materials.

In this issue of *Chemical Synthesis*, Liu *et al.*^[7] gave an overview of nascent topics on CPL generated by inorganic materials [Figure 1]. In this review, the authors firstly introduced the basics of CPL, and subsequently summarized three common construction strategies for inorganics-associated CPL-active materials, including: (1) inorganic luminophores with intrinsically chiral structures; (2) inorganic luminophores with chiroptical activity induced by chiral organic ligands; (3) chiral inorganic nanomaterials



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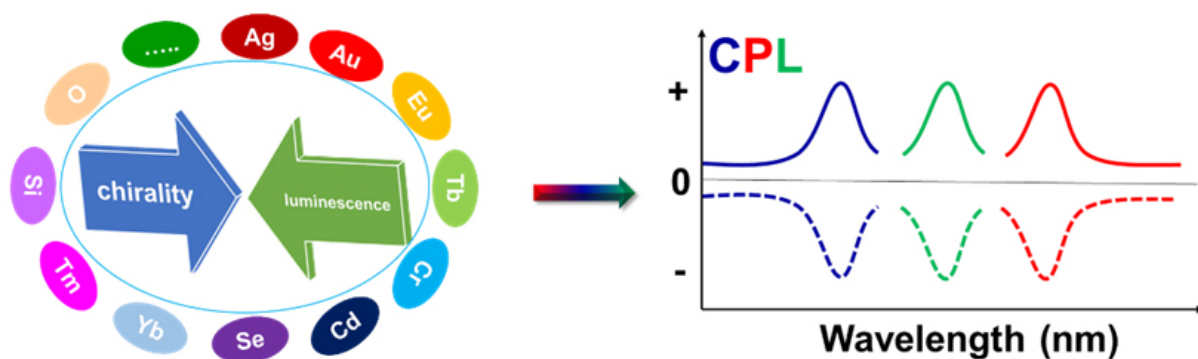


Figure 1. Schematic of CPL spectra generated by various inorganic matter through the combination of chirality and luminescence. CPL: Circularly polarized luminescence.

combined with luminophores.

The above construction methodologies are further clarified in the following two aspects: 1) endowing common inorganic luminophores with CPL, which are demonstrated by lanthanide ions, transition metal ions, metal clusters, semiconductor nanocrystals, carbon dots, and perovskite nanocrystals; 2) the usage of chiral inorganic materials as chirality sources for CPL, which include chiral nano-silica, inorganic nanocrystals and assemblies. Moreover, many CPL-related properties of these materials are summarized, which include luminophores, chirality sources, excitation/emission bands, quantum yields, and g_{lum} .

In many reports, CPL is based on down-conversion fluorescence with emission bands in the visible light spectrum. Different from this common CPL, the authors continued to introduce some special CPL-active systems featured with up-conversion, NIR emission, thermally activated delayed fluorescence (TADF), and room-temperature phosphorescence. Furthermore, they demonstrate the potential applications of inorganics-based CPL in various areas such as sensors, anti-counterfeiting, optical storage, and asymmetric synthesis.

As for the future study of inorganics-associated CPL-active systems, the authors also put forward their own perspectives on the acquisition of reliable CPL data, improving g_{lum} , evaluation of CPL properties, understanding CPL mechanism, and exploring CPL-related applications.

In summary, Liu *et al.*^[7] provided readers with an overview of CPL generated by inorganic materials. These pieces of information are valuable to give insights and guidelines for the design of inorganics-associated CPL-active systems with improved CPL effects and novel applications. We are waiting for more amazing optical events.

DECLARATIONS

Authors' contributions

The author contributed solely to this manuscript.

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Conflict of interest

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Ethical approval and consent to participate

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Consent for publication

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