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Cyclodextrin-based Metal-Organic Frameworks CD-MOFs

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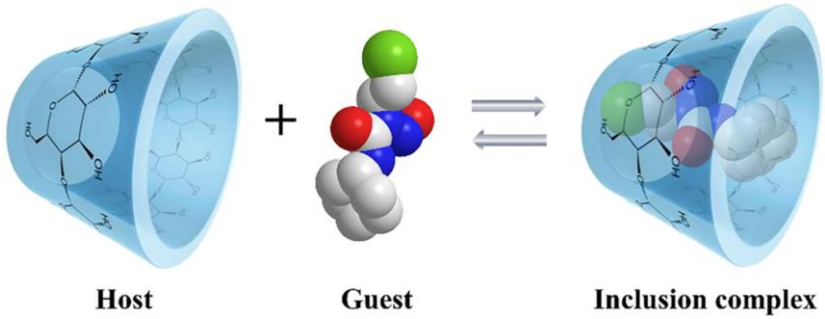
What are CDs and MOFs?

Cyclodextrins (CDs)

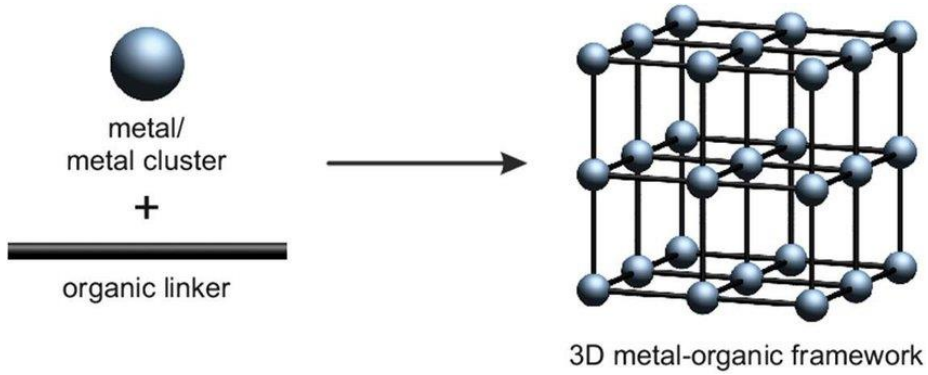
- Natural, cyclic molecules, composed of sugars.
- Toroid structure with interior hydrophobic cavities and exterior hydrophilic rims.
- Hydrophobic molecules can be incorporated.
- Often, the **aim** is to increase the solubility, dissolution rate, and stability of poorly soluble APIs.



Dynamic host-guest interaction

Metal-Organic Frameworks (MOFs)

- Materials composed of **metal ions** or clusters connected by **organic molecules (linkers)**
- Cage-like structure with tunable porosity and high surface area
- Application: gas storage, separation, catalysis, drug delivery, etc.



Schematic figure of MOFs

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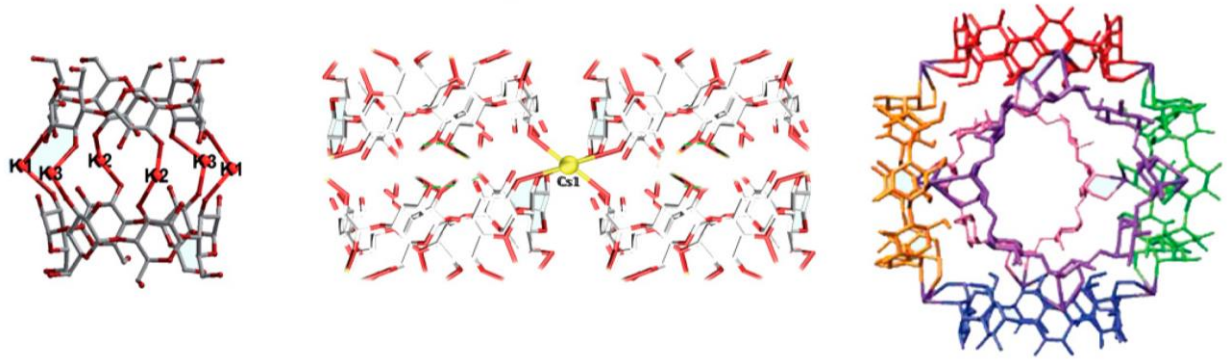
What are CD-MOFs?

MOFs containing CDs as linkers (CD-MOFs)

These hybrids combine the characteristics of both cyclodextrins and MOFs, offering unique properties and applications.

α-CD β-CD γ-CD



Schematic diagram of coordination between α/β/γ CDs and metal ions[1]

Benefits

Versatility

Create MOFs with tailored properties for different applications

Functional Groups

Functional groups of CDs enable precise control over the structure.

Biocompatibility

Biocompatibility and low toxicity allow for use in drug delivery systems.

Enhanced Stability

Incorporating CDs as linkers can enhance the stability of the resulting MOFs

[1]Han, Y.; et al. CD-MOFs in Pharmaceutics and Biomedicine. Pharmaceutics 2018, https://doi.org/10.3390/pharmaceutics10040271

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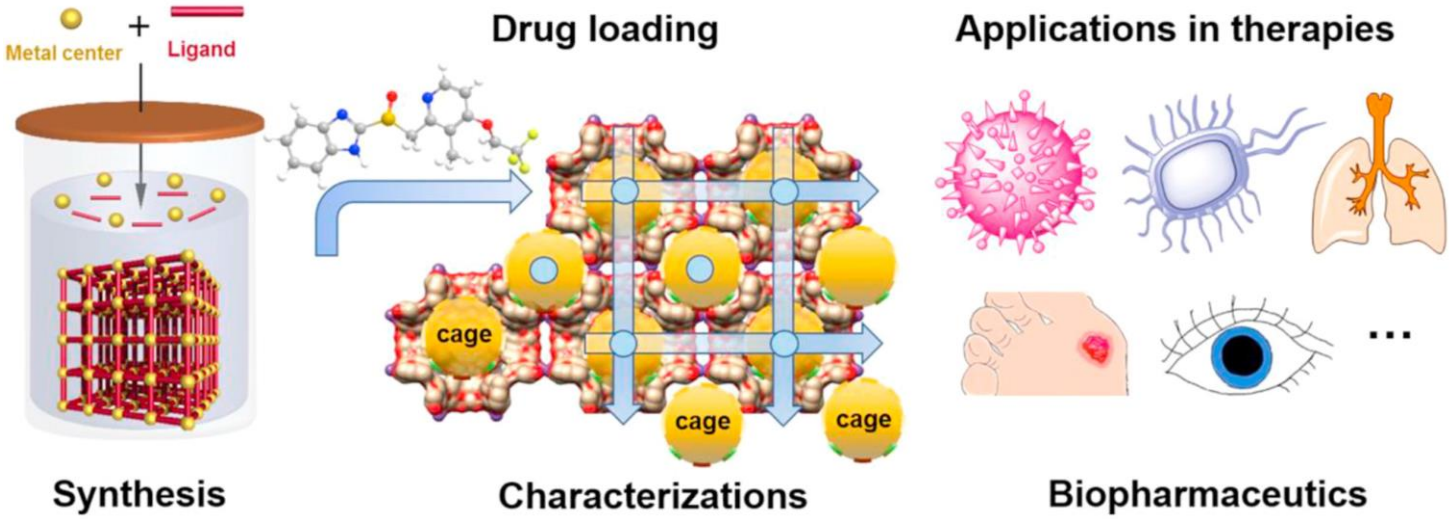
CD-MOFs in Drug Delivery



MOF-based systems used in advanced drug delivery.[1]

Drug	Loading capacity (%)
Lansoprazole	21.0-25.0
Fenbufen	19.0-20.0
Ibuprofen	23.0-26.0
Ketoprofen	2.4-4.4
Sucralose	17.5-28.0
Capsaicin	-
Ibuprofen	12.70
Fenbufen	19.60
Doxorubicin	6.0-8.0
Acetaldehyde	0.0053-0.0030

Loading capacity of CD-MOFs with various drugs.[2]

[1]Siyu He, et al. Metal-organic frameworks for advanced drug delivery, Acta Pharmaceutica Sinica B, 2021, https://doi.org/10.1016/j.apsb.2021.03.019.
[2]Asma Hamedi et al. γ-CD-MOF: a review of recent advances for drug delivery application, Journal of Drug Targeting, 2022, https://doi.org/10.1080/1061186X.2021.2012683

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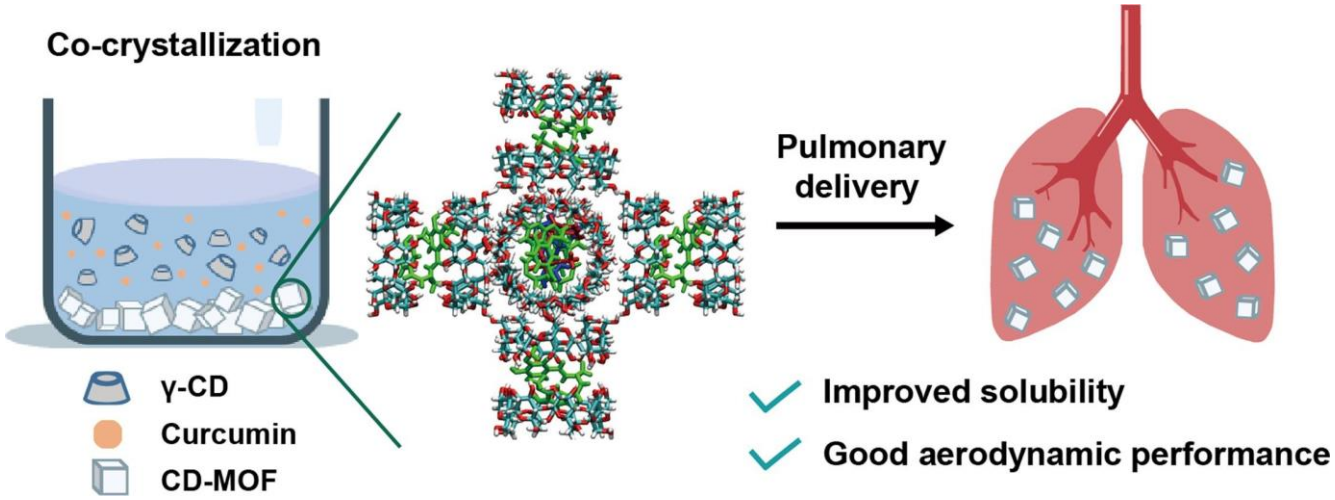
CD-MOFs in Drug Delivery

Pulmonary administration

- Porous CD-MOF containing poorly soluble **curcumin**
- Cubic shape and **uniform porous structure** with a large surface area
- Resulting **excellent aerodynamic behavior**, but also effectively **boosted the solubility and dissolution rate** of curcumin



Pulmonary delivery of curcumin with improved solubility and fine aerodynamic performance.[1]

[1]Yixian Zhou, et al. Cyclodextrin-based metal-organic frameworks for pulmonary delivery of curcumin with improved solubility and fine aerodynamic performance, International Journal of Pharmaceutics, 2020 https://doi.org/10.1016/j.ijpharm.2020.119777.

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