Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting information

Novel γ-cyclodextrin-based metal-organic frameworks for the effective encapsulation of oregano essential oil and controlled release

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1. Characterization methods of samples

The crystalline structure of samples (γ-CD-MOFs and ICs) was determined by X-ray diffraction (XRD) using Smart Lab 9 kW (Rigaku, Japan) operating at 40 kV and 200 mA Cu radiation. The analytical diffractograms were collected at a 2 θ angle range of 3-40° with a stepwise scan mode of 5°·min^{-1} and a step size of 0.02.

The microstructure of γ-CD-MOFs and ICs was observed by field-emission scanning electron microscopy (SEM) in a Regulus 8100 (Hitachi, Japan). All samples were placed on conductive adhesive, and then gold coated for better image quality. The morphology and size of samples were investigated using SEM. The particle size of samples was determined from SEM images, and particle size and distribution of samples were analyzed using Image J software (Image J 1.53t), with a minimum of 200 particles for each sample. Moreover, field emission transmission electron microscopy (TEM) (JEM F200, JEOL, Japan) was used to characterize morphology and composition of prepared γ-CD-MOFs.

BET specific surface area of samples was determined by the static volume method using liquid nitrogen (N_2) at a specific temperature (77 K) using BELSORP MAX surface area and pore size distribution analyzer (Mirrorable, Japan). Prior to testing, each sample was degassed at 80 °C for 5 h. The specific surface area and pore volume of samples were calculated based on the adsorption isotherm method using the Braeuer-Emmett-Teller (BET) equation, and pore size distribution was analyzed by the Horvath-Kawazoe (HK) method.

The interaction between γ-CD-MOFs and OEO was measured using a Fourier transform infrared spectrometer (FT-IR) Nicolet iS5 (Thermo-Fisher, USA). FT-IR spectra of samples were recorded within the range 400–4000 cm^{-1} with 64 successive scans at a resolution of 4 cm^{-1}.

The thermal stability of samples was tested by thermogravimetric analysis (TGA) in a SDT Q600 (TA, USA) under N_2 flow and heating within the range of 30-600 ℃ at an increasing heating rate of 10 ℃·min^{-1}.

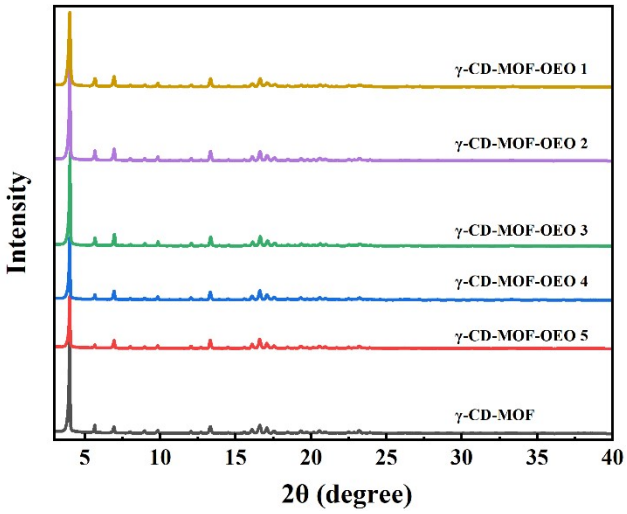

Fig. S1. XRD patterns of ICs and unloaded γ-CD-MOF.

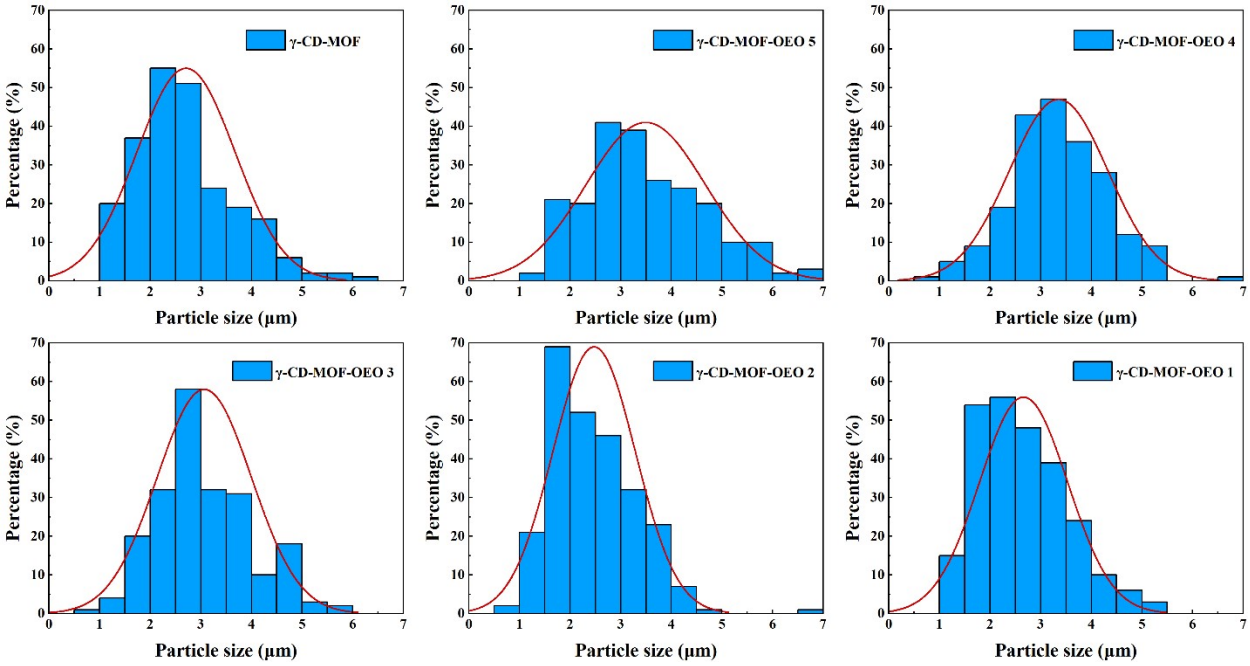

Fig. S2. Particle size distribution of ICs and unloaded γ-CD-MOF.

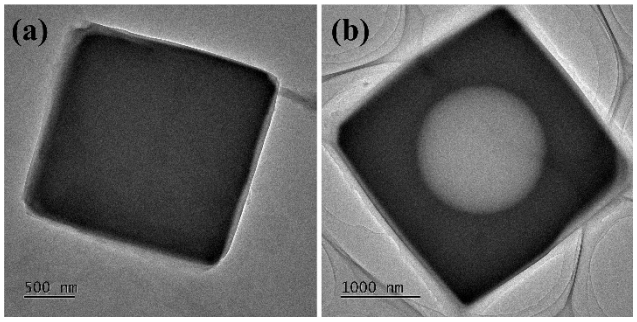

Fig. S3. TEM images of γ-CD-MOF-OEO 1.