

## Polymerized Ionic Liquid Co-Catalysts Driving Photocatalytic CO<sub>2</sub> Transformation

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## S1 Fourier transform infrared spectroscopy of synthesized materials:

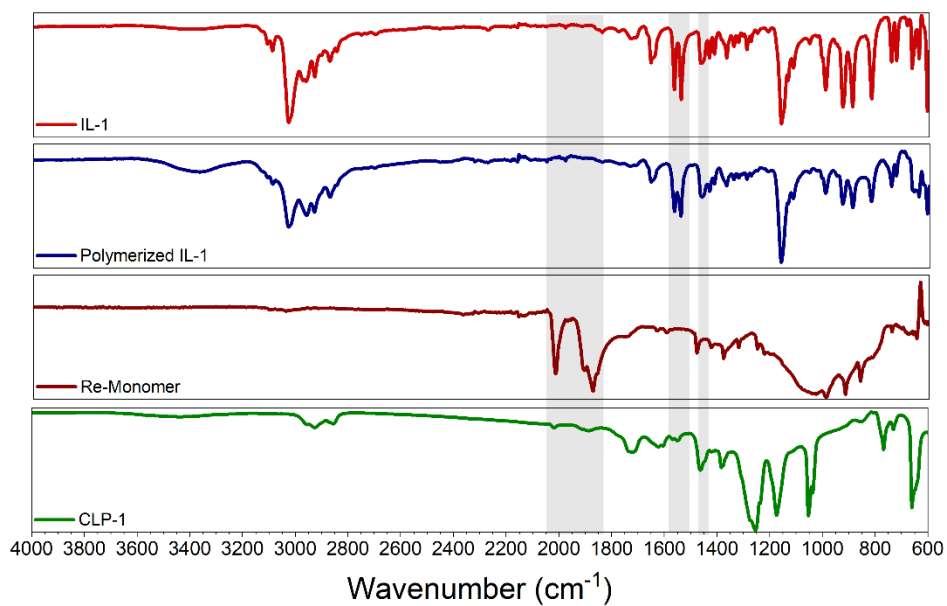


Figure S1: FT-IR spectroscopy of ionic liquid (IL-1)( red), polymerized ionic liquid (PIL) (blue), Re-Monomer (and CLP-1

## S2 Thermogravimetric analysis of polymers:

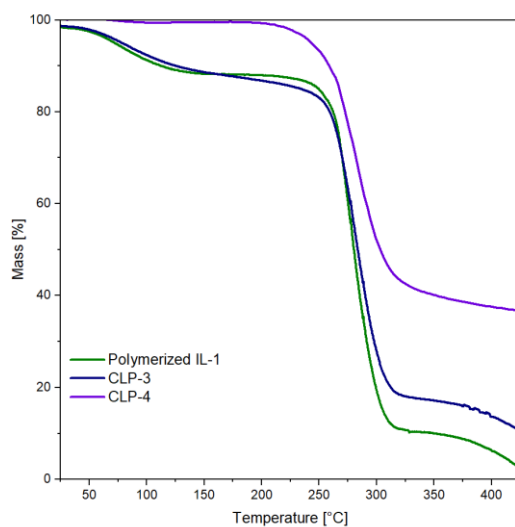


Figure S2: TGA of polymerized IL-1, CLP-3 and CLP-4

### S3 XPS Survey spectra of CLP-1:

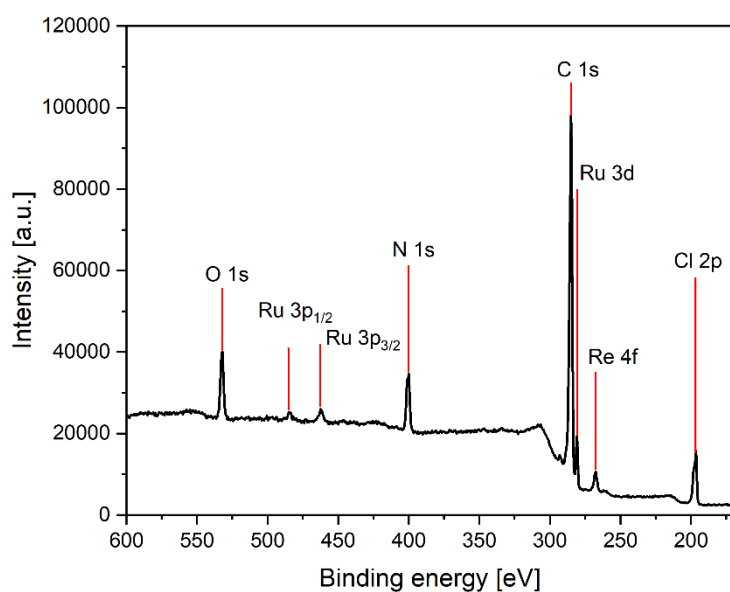


Figure S3: XPS Survey spectra of CLP-1.

### S4 XPS detailed scans of Cl 2p:

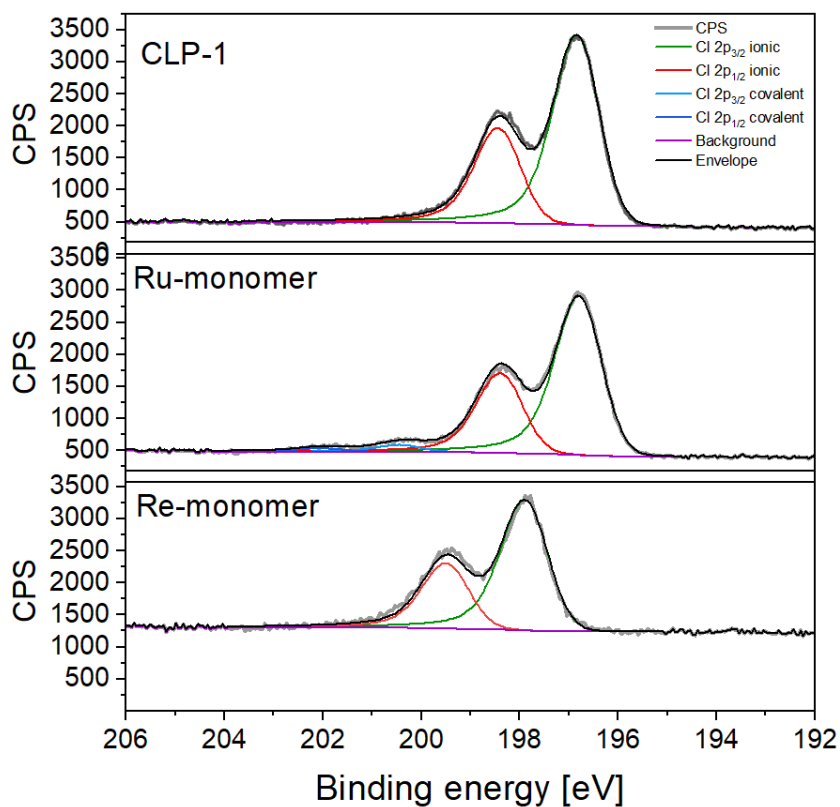


Figure S4: XPS detailed scans of Cl 2p.

S5 XPS detailed scans of N 1s:

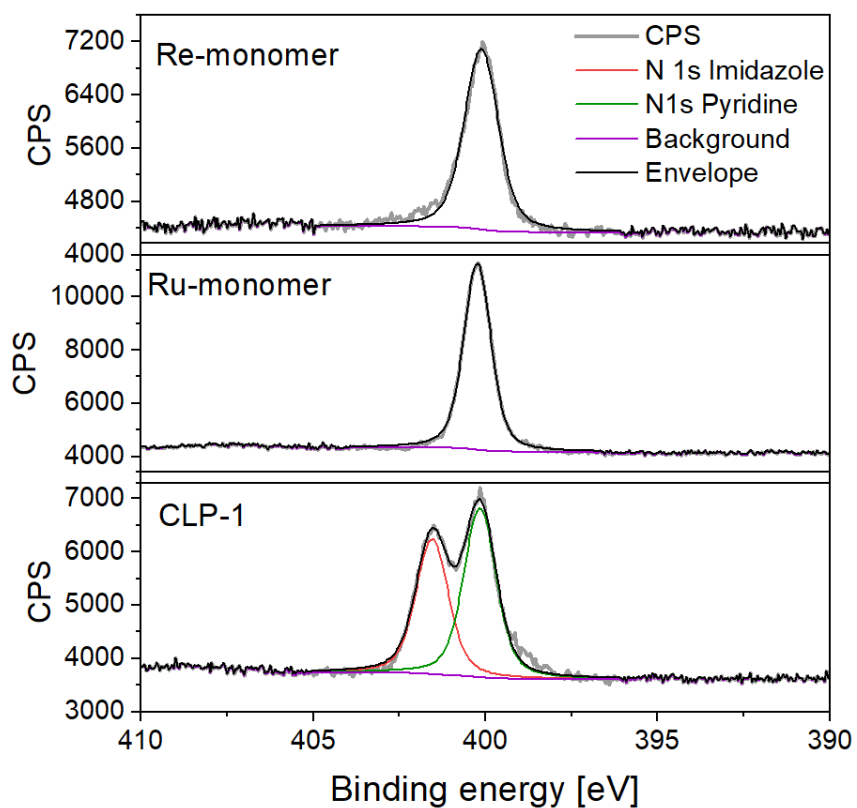


Figure S5: XPS scans of N 1s.

S6 LA-ICP-MS scan lines:

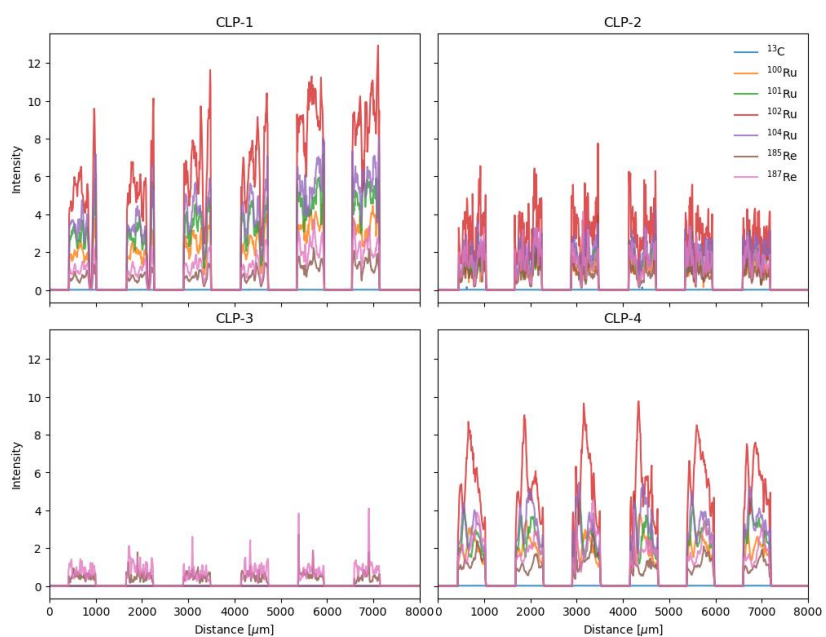


Figure S6: LA-ICP-MS Scans of isotopes in polymers CLP-1 to CLP-4

S7 EDX scans of sample particles:

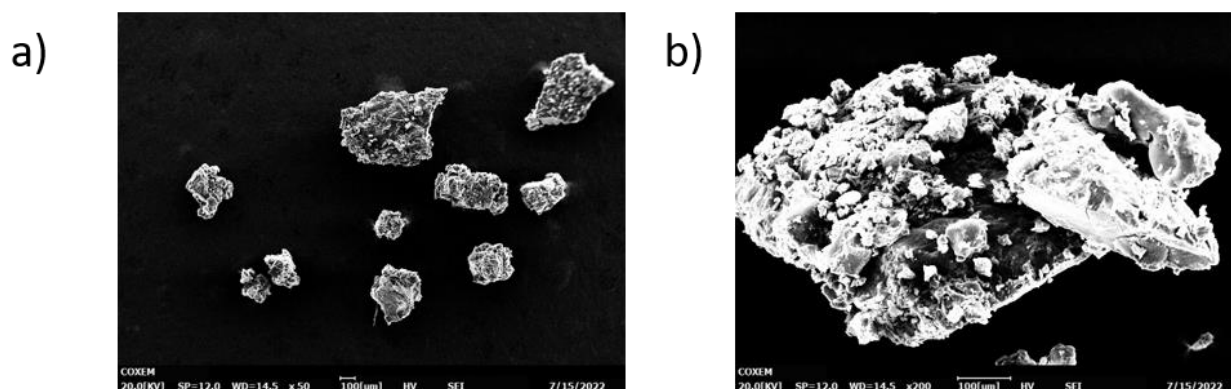


Figure S7: EDX Scans of sample particles of CLP-1. Several particles (a) and closeup (b).

S8 UV-Vis spectroscopy of aged reaction solution:

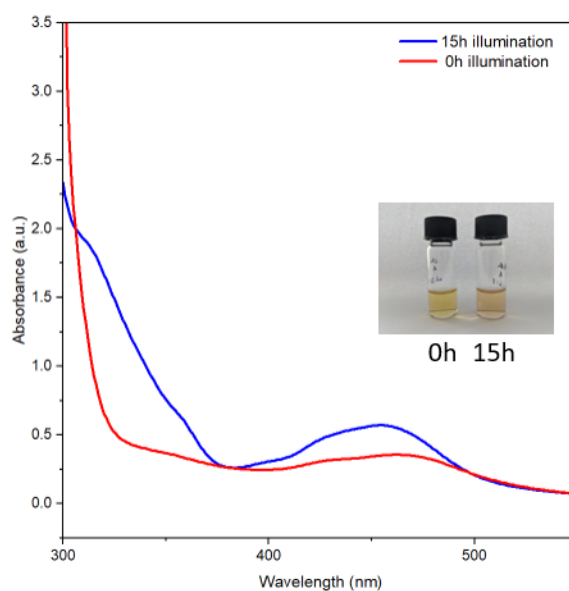


Figure 8: UV Vis spectra of reaction solution after 15h of illumination (blue) and 0h of illumination (red).

S9 Calculations of Reaction parameters:

Reactor parameters:

Reactor volume (ml)	3.7
Reaction volume (ml)	1.5
Reactor headspace (ml)	2.2
Reaction time (sec)	53000

Conversion from ppm to Gas volume in mL:

$$\text{Gas volume in mL} = \frac{\text{ppm} \times \text{Reactor headspace (mL)}}{10^9}$$

Calculation of gas amount in moles by ideal gas law:

$$n(\mu\text{mol}) = \frac{pV}{RT}$$

With parameters:

P is pressure = 101.325 Pa

R is gas constant = 8.314 J mol<sup>-1</sup> K<sup>-1</sup>

T is temperature = 295 K

Turnover number (TON) is calculated as following:

$$\text{TON} = \frac{\text{number of moles of CO}}{\text{number of moles of catalyst}}$$

The turnover frequency (TOF) can be calculated from TON divided by the reaction time in minutes:

$$\text{TOF (min}^{-1}\text{)} = \frac{\text{TON}}{\text{time [min]}}$$

The instant TOF is defined as the first derivative (d) of TON against time:

$$\text{Instant TOF (min}^{-1}\text{)} = \frac{d(\text{TON})}{d(\text{time})}$$