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Selective separation of uranyl ions from some lanthanide elements using a promising *β*-enaminoester ligand by cloud point extraction

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Supplementary Material

Figure Caption

Figure. S1. The geometry forms of cyclic *β*-enaminones

Figure. S2. IR for the *β*-enaminoester ligand.

Figure. S3. ^{1}H-NMR for the *β*-enaminoester ligand.

Figure. S4. ESI-MS for the *β*-enaminoester ligand.

Figure S5. Optimized geometries of the ligand and its UO_2^{2+} complex

Figure. S6. Effect of Triton X-114 on the complex formation between uranyl ions and enaminoester. Optimized conditions: volume of sample, 50 mL; pH, 4.5; UO_2^{2+}, 100 ng mL^{-1}; KI, 0.1 mol L^{-1}; Enaminoester, 5.0×10^{-3} mol L^{-1}.

Figure. S7. Effect of enantiomer concentration on the uranyl extraction by the CPE. Optimized conditions: volume of sample, 50 mL; pH, 4.5; UO_2^{2+}, 100 ng mL^{-1}; KI, 0.1 mol L^{-1}; Triton X-114, 5.0×10^{-4} mol L^{-1}.

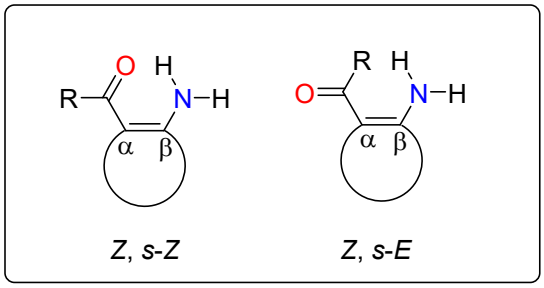

Figure. S1

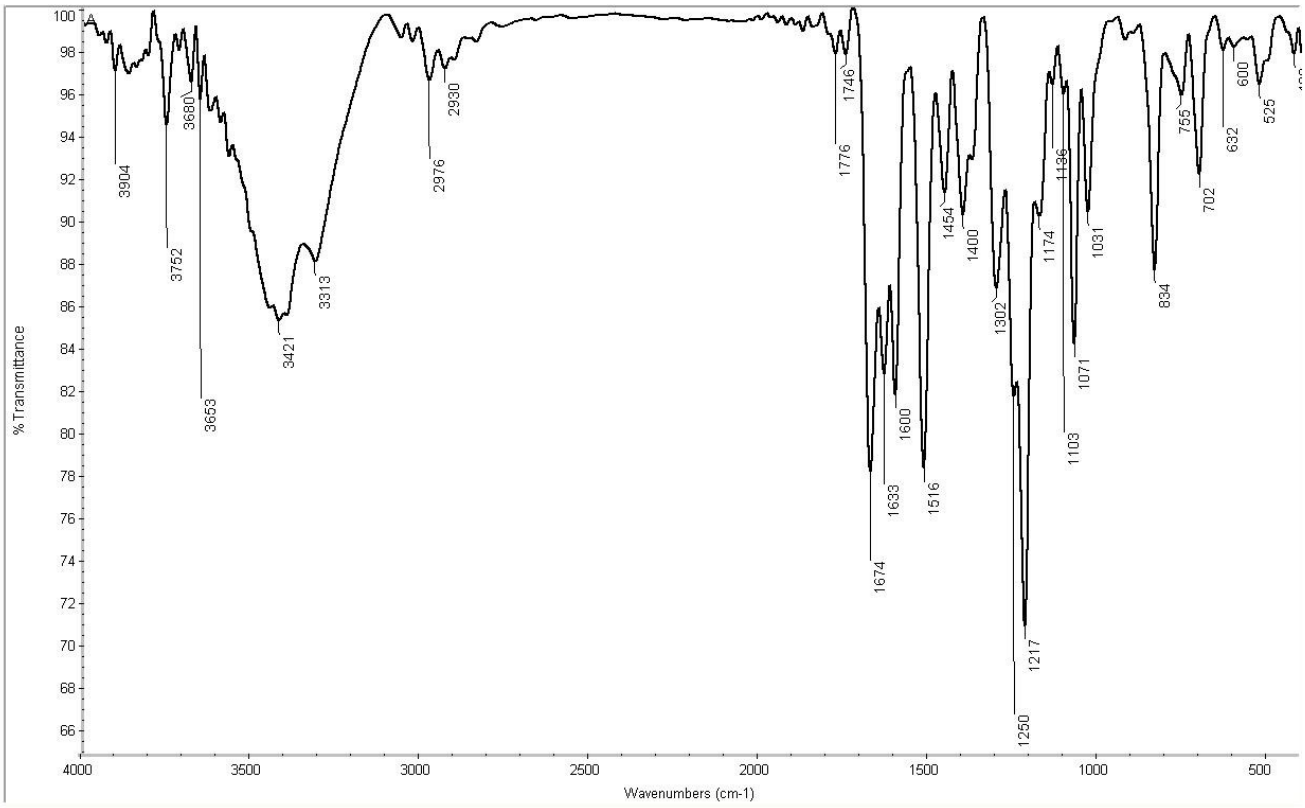

Figure. S2

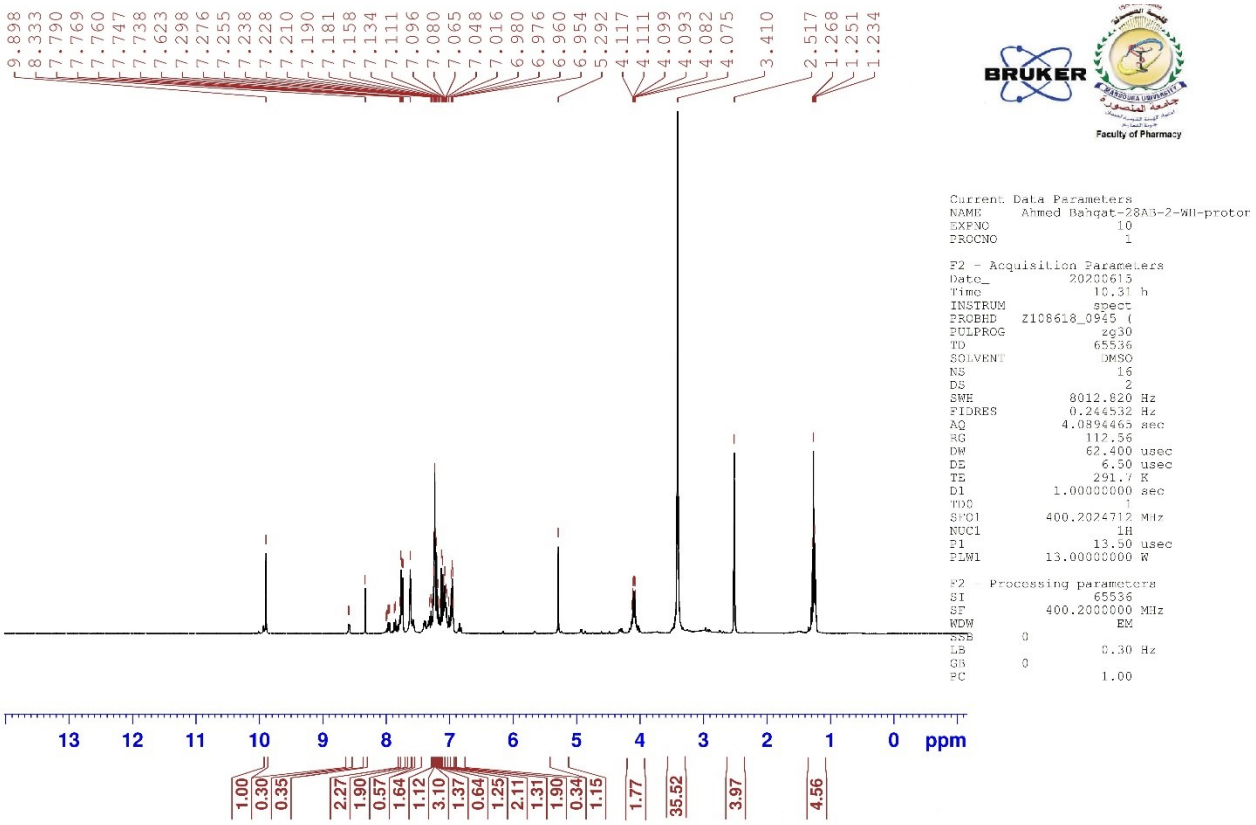

Figure. S3

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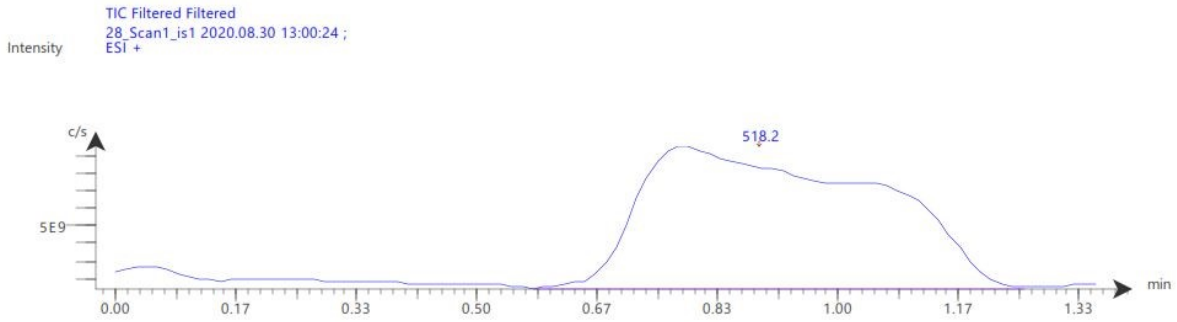
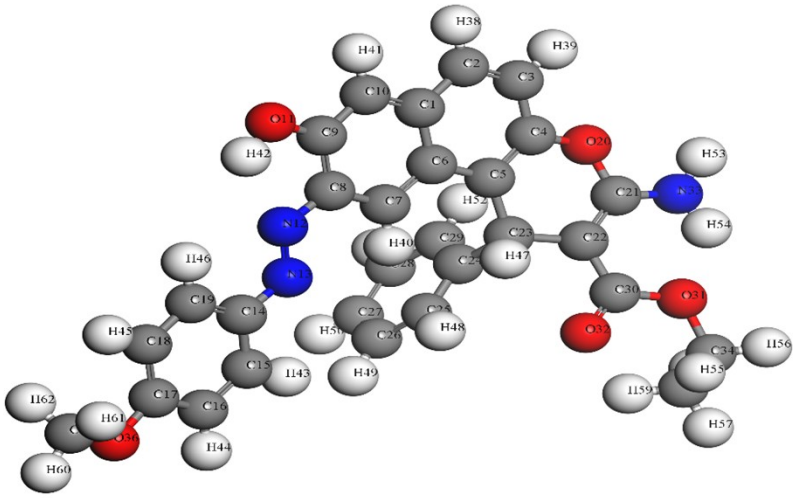


Time (Peak Maximum M:S/Minutes)	Maximum Intensity (c/s)	Time (Peak Centroid M:S/Minutes)	Peak Area	% Peak Area	Peak Resolution	Base Peak Mass (m/z)	Label
0.04	4.498E8	0.04	1.941E9	1.1	4.2	299.9	
0.20	1.087E8	0.21	8.748E8	0.5	5.7	300.0	
0.49	1.437E8	0.48	7.045E8	0.4	9.5	487.4	
0.78	8.111E9	0.89	1.801E11	98.1	25.3	518.2	

Figure. S4

A



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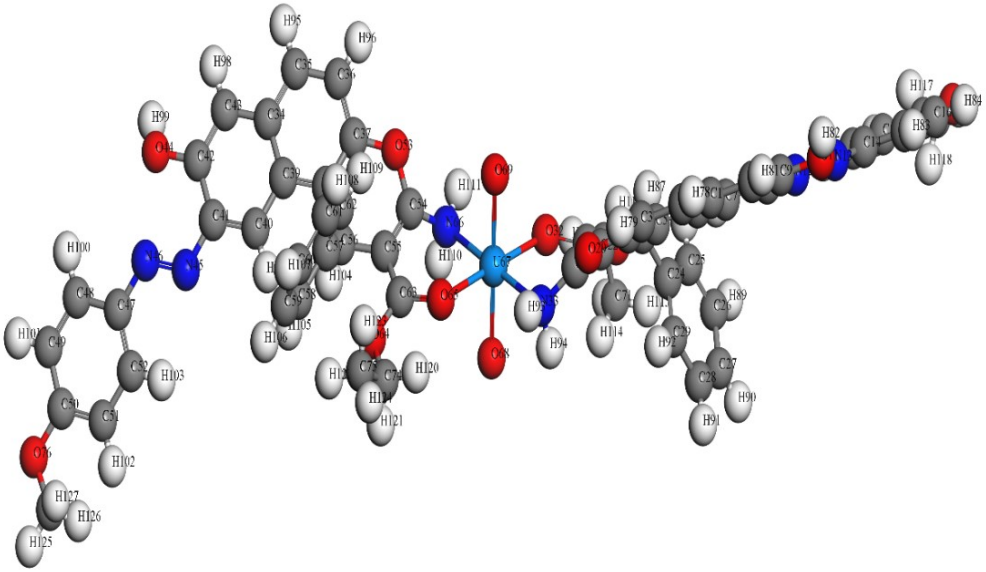

Figure. S5

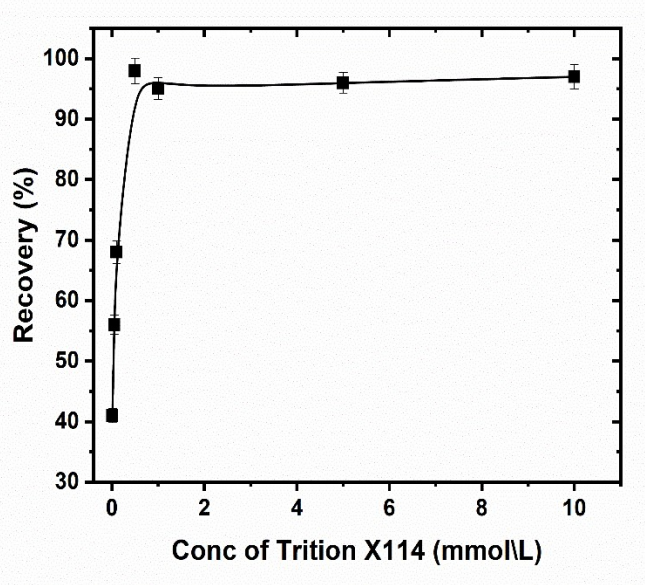

Figure. S6

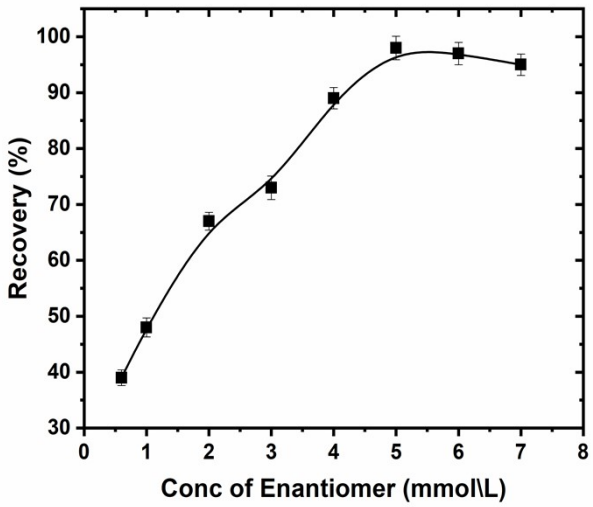

Figure. S7

Table Caption

Table. S1. Instrumental parameters for uranyl determination using ICP-OES.

Table S2: Selected bond lengths and bond angles for the ligand and its complex.

Table S3. The analytical performance of the proposed CPE method

Table. S1.

Parameter	Range
RF power (W)	1200
Flow rate of plasma gas (L min^{-1})	12
Flow rate of auxiliary gas (L min^{-1})	1
Flow rate of nebulizer gas (L min^{-1})	0.7

Table S2

Compound	Bond lengths (Å)		Bond angles (°)	
Enaminoester ligand	C^{30}-O^{31}	1.42	O^{32}-C^{30}-C^{22}	124.14
	C^{30}-O^{32}	1.27	N^{33}-C^{21}-C^{22}	127.98
	C^{21}-N^{33}	1.37		
UO_2^{2+} complex	C^{30}-O^{31}	1.51	O^{32}-C^{30}-C^{22}	124.56
	C^{30}-O^{32}	1.52	N^{33}-C^{21}-C^{22}	123.66
	C^{21}-N^{33}	1.52		
	O^{32}-U^{67}	2.46	O^{69}-U^{67}-O^{68}	179.76
	N^{33}-U^{67}	2.47	N^{33}-U^{67}-O^{32}	87.890
	O^{65}-U^{67}	2.47	N^{66}-U^{67}-O^{65}	88.430
	N^{66}-U^{67}	2.47	N^{66}-U^{67}-O^{32}	91.690
	U^{67}-O^{69}	2.48	O^{65}-U^{67}-N^{33}	91.990
	U^{67}-O^{68}	2.48	N^{66}-U^{67}-N^{33}	179.52
			O^{65}-U^{67}-O^{32}	178.86

Table S3.

Parameter	Value
Concentration range	3 ng mL^{-1} to 250 ng mL^{-1}
LOD	0.5 ng mL^{-1}
LOQ	1.6 ng mL^{-1}
Reproducibility	2.4% (RSD)
Repeatability	1.9 (RSD)