

Zr-Based Biocomposite Materials as an Alternative for Fluoride Removal, Preparation and Characteristics

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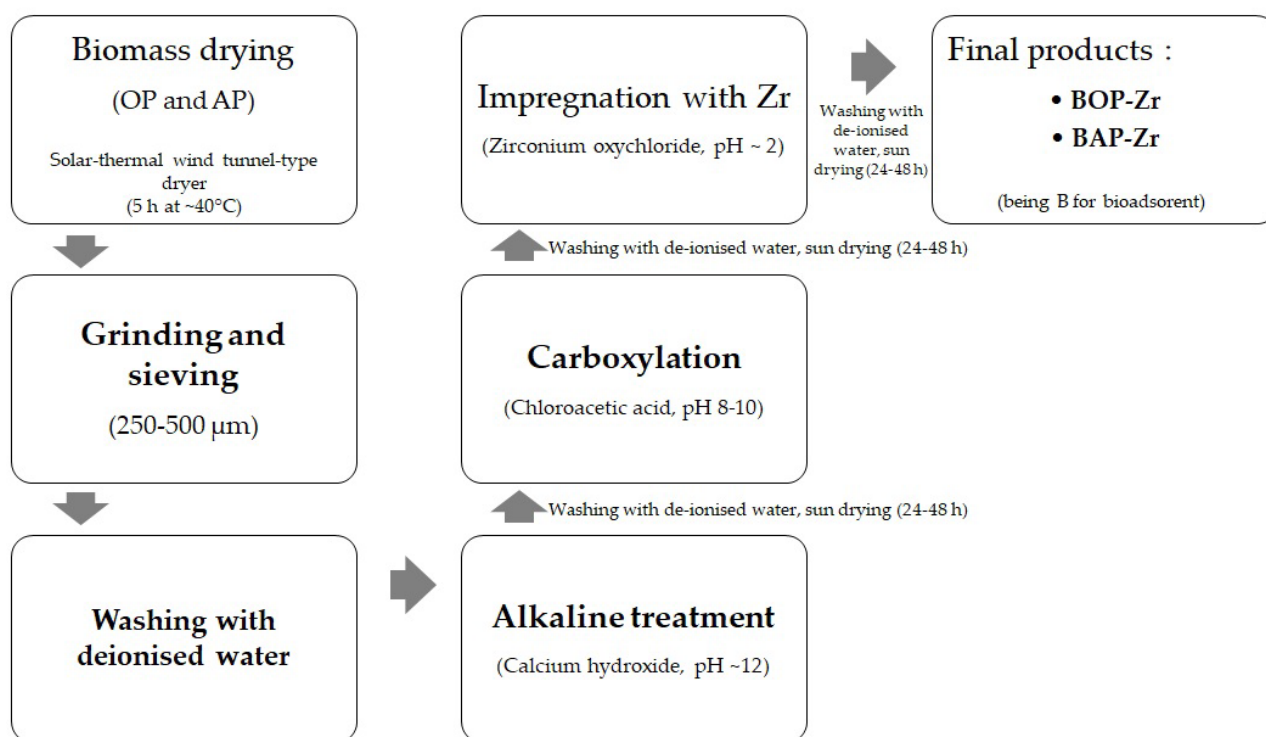


Figure S1. Bioadsorbent preparation process.

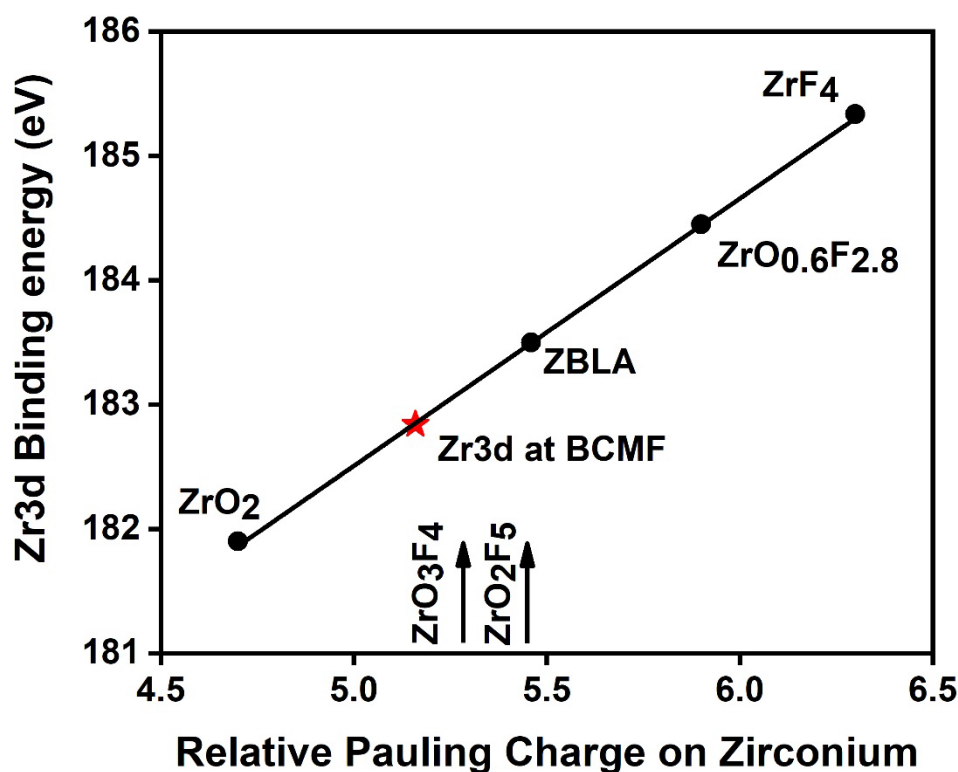


Figure S2. Relationship between the Zr3d binding energy and the Pauling charge in the Zr species of Pantano and Brow, 1988 [62] and of the present study ★.

Table S1. Summary of parameters analyzed by the BET method

Sample	Surface area (m ² /g)	Pore volume (cm ³ /g)	Pore size (nm)
BOP-Zr	0.751	0.00141	6.070
BAP-Zr	0.521	0.00066	5.060

Table S2. Physico-chemical characterization of groundwater from the state of Durango, México.

Parameter	Measured value
pH	8.7
Electrical conductivity (µs/cm)	548.25
DQO (mg O ₂ /L)	104
Na ⁺ (mg/L)	53.10
K ⁺ (mg/L)	9.88
Ca ⁺² (mg/L)	60.55
Mg ⁺² (mg/L)	1.54
F ⁻ (mg/L)	3.89
NO ₃ ⁻ (mg/L)	38.36
NO ₂ ⁻ (mg/L)	1.84
Cl ⁻ (mg/L)	26.39
CO ₃ ⁻² (mg/L)	0
HCO ₃ ⁻ (mg CaCO ₃ /L)	148.50
SO ₄ ⁻² (mg/L)	59.76
As Total (mg/L)	0.032
As Total=As ⁺⁵ +As ⁺³	

Table S3. Peak Deconvolution peaks on bioadsorbents before and after adsorption.

Species	Peak's binding energy (Ev)				Area CPS.Ev			
	BOP-Zr	BOP-Zr-F	BAP-Zr	BAP-Zr-F	BOP-Zr	BOP-Zr-F	BAP-Zr	BAP-Zr-F
C1s (C-C, C-H)	284.75	284.72	284.80	284.75	6738.19	7211.94	14292.11	9897.90
C1s (C-O-C, C-OH)	286.12	286.36	286.52	286.10	4183.31	6444.94	1430.80	3315.20
C1s (C=O)	287.70	288.11	288.80	288.37	2948.47	3419.43	309.94	675.61
O1s (O ²⁻)	530.30	Disappear	529.91	529.80	541.40	-	98.97	341.51
O1s (OH ⁻)	532.50	532.65	532.35	532.42	10747.82	13943.75	3452.99	6268.26
O1s (H ₂ O)	534.63	Disappear	534.18	534.40	858.92	-	145.58	159.04
O1s (O-Fx)	-	535.23	-	-	-	1191.43	-	-
Zr3d_{5/2}	182.84	182.87	182.63	182.84	1713.71	1646.20	404.64	952.61
Zr3d_{5/2}	184.85	184.79	184.85	185.08	1196.70	1030.79	215.57	474.95
Zr3d_{3/2}	185.53	185.54	185.00	185.41	521.89	709.44	148.36	150.17
Zr3d_{3/2}	186.94	187.04	186.73	185.35	242.20	523.78	47.05	103.35
ZrF₄	-	685.0	-	685.49	-	327.71	-	205.39
ZrO₃F₄	-	689.77	-	689.43	-	467.44	-	268.61