

## Supporting Information

### Thiol-Silylated Cellulose Nanocrystals as Selective Biodepressants in Froth Flotation

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Table S1. Particle diameter of quantile sizes and mean diameter of chalcopyrite and pyrite.

Size quantiles	Chalcopyrite		Pyrite	
	Fine	Coarse	Fine	Coarse
D <sub>10</sub> /μm	1.3 ± 0.1	69.7 ± 0.2	2.1 ± 0.1	73.2 ± 0.1
D <sub>50</sub> /μm	3.4 ± 0.2	116.8 ± 0.3	4.7 ± 0.2	121.9 ± 0.2
D <sub>90</sub> /μm	12.7 ± 0.7	169.9 ± 0.4	50.3 ± 2.5	187.4 ± 0.5
Mean/μm	5.1 ± 0.6	116.2 ± 0.2	16.2 ± 0.3	125.8 ± 0.1

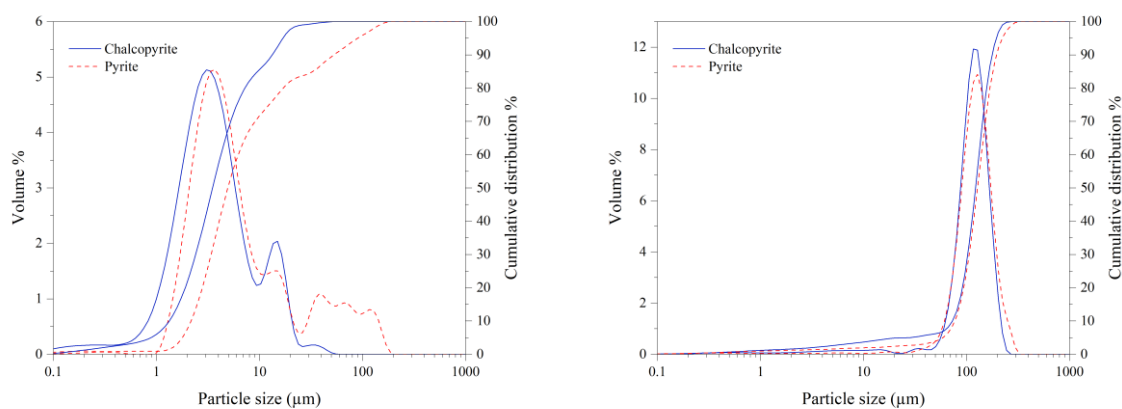


Figure S1. Particle size distribution of fine (left) and coarse (right) fractions of chalcopyrite and pyrite.

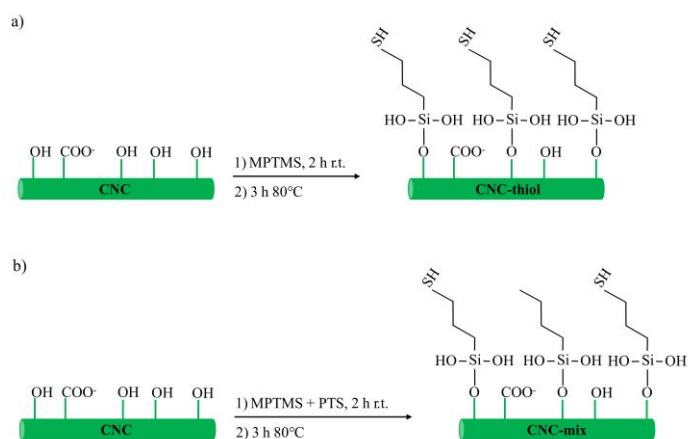


Figure S2. Synthesis of **a)** CNCs containing thiol silane group (CNC-thiol) and **b)** CNCs containing thiol and propyl silane groups (CNC-mix) via aqueous silylation.

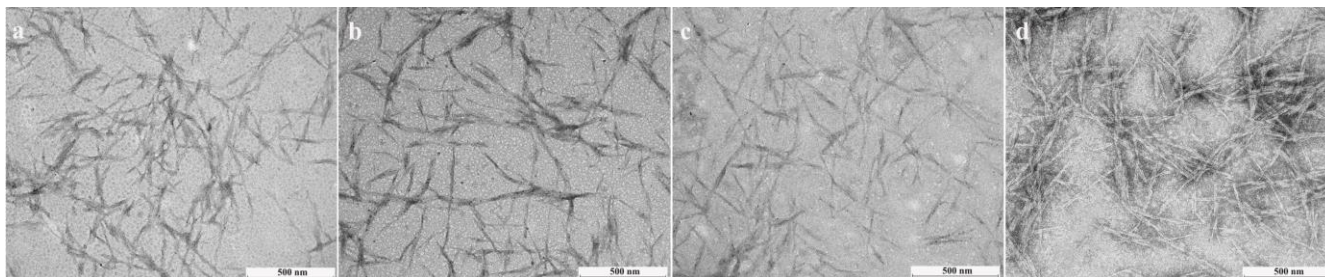


Figure S3. TEM images of functionalized CNCs: a) CNC-thiol I, b) CNC-mix I, c) CNC-thiol II, and d) CNC-mix II.

Table S2. Composition of pristine and functionalized CNCs from XPS analysis.

Sample	Surface composition (%)			
	O1s	C1s	Si2p	S2p
CNC	42.40	57.61	-	-
CNC-thiol I	43.57	54.75	0.96	0.71
CNC-mix I	43.28	52.73	2.78	1.20
CNC-thiol II	39.97	52.08	4.47	3.35
CNC-mix II	40.49	54.39	4.69	0.43

Table S3. Grafting amount and static contact angle of pristine and silylated CNCs (n = 6).

Sample	Cellulose-MPTMS (-PTS) mass ratio	Grafting amount (mmol/g)		Static contact angle ( $\theta$ )
		Si	S	
CNC	-	-	-	$29.6 \pm 3.6$
CNC-thiol I	1:0.5	0.34	0.22	$38.1 \pm 3.5$
CNC-thiol II	1:1	1.59	1.05	$68.6 \pm 1.0$
CNC-mix I	1:0.5:0.5	0.99	0.37	$62.2 \pm 1.5$
CNC-mix II	1:1	1.67	0.13	$52.5 \pm 3.6$

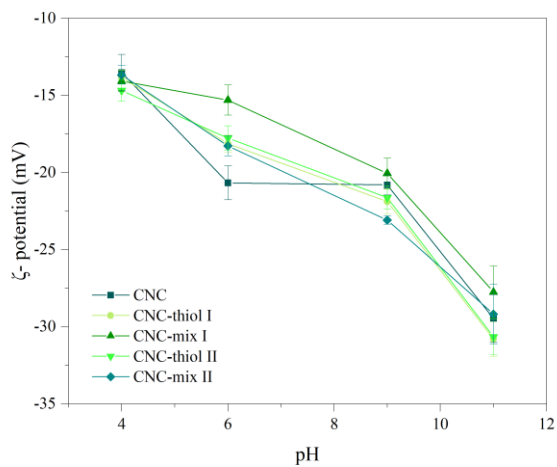


Figure S4.  $\zeta$ -potential of pristine and silylated CNCs; error bars represent single standard deviation ( $n = 6$ ).

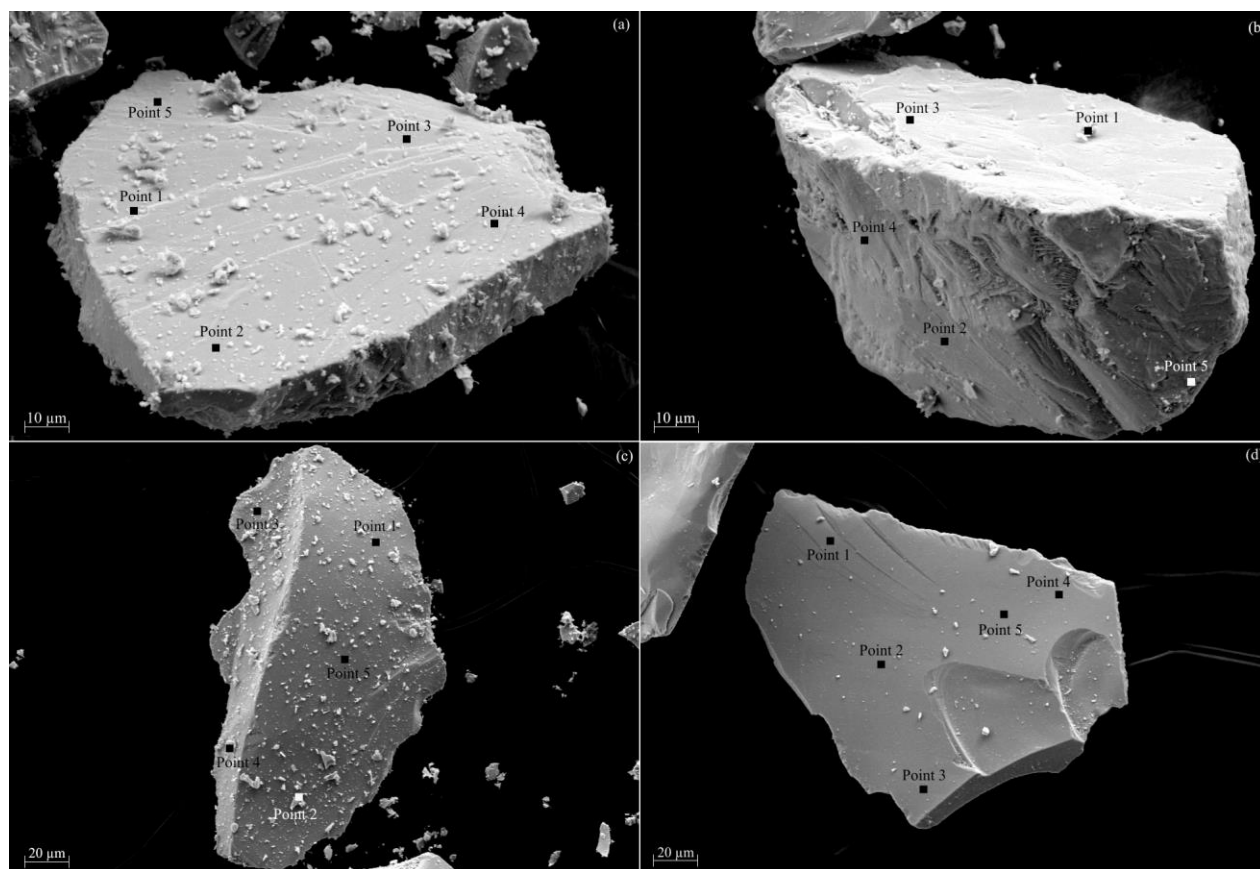


Figure S5. FESEM images of (a) chalcopyrite, (b) chalcopyrite and CNC-thiol II (2.5 mg/L), (c) pyrite, and (d) pyrite and CNC-thiol II (2.5 mg/L).

Table S4. Elemental composition (% w/w) of chalcopyrite and pyrite in the presence and absence of CNC-thiol II with standard deviations (n = 5).

	Chalcopyrite	Chalcopyrite and CNC-thiol II	Pyrite	Pyrite and CNC-thiol II
	% w/w			
O	n.d.	12.20 ± 10.34	n.d.	n.d.
Si	n.d.	0.82 ± 0.41	n.d.	n.d.
S	28.74 ± 0.15	19.12 ± 10	50.91 ± 2.79	52.51 ± 0.50
Fe	24.09 ± 0.15	36.40 ± 15.53	47.97 ± 2.59	45.87 ± 0.40
Cu	46.62 ± 0.65	31.08 ± 12.75	n.d.	n.d.