**S1 Table. Raman peak assignment.** Unassigned peaks were detected in pure component analysis (see Fig. 1) but lack assignment in literature. If reduced (red) and oxidized (ox) species can be differentiated, it is mentioned in the table. For molecular schemes, please see references.

Component	Raman shift (cm <sup>-1</sup> )	Assignment	Reference
Cytochromes	775 (red)	$ u_{15}$ pyrol breathing	(1,2)
	978 (red) 987 (ox)	$V(C_c, C_d)$	(2)
	1034	<i>v</i> <sub>31</sub>	(2)
	1235	V <sub>13</sub>	(1,2)
	1274 (red)		
	1331	$v_{21}$ or $\delta(C_aH)$	(1,2)
	1359	$V_4$	(1,2)
	1478		
	1531		
	1572	<b>V</b> <sub>19</sub>	(2)
Flavins (red/ox)	528/-		
	613/616		
	736/738	Ring I deform	(3)
	801/801	Ring I deform, C <sub>6</sub> -H bend, N₃-H bend	(3)
	1143/1153	Ring I and Ring III modes	(3)
	1257/-	Ring I modes, N <sub>5</sub> -H, C <sub>6</sub> -H, C <sub>9</sub> -H bend	(3,4)
		If resonance: C <sub>5a</sub> -N <sub>5</sub> , N <sub>3</sub> -C <sub>4</sub>	
		No resonance: C <sub>2</sub> -N <sub>3</sub> str	
	1340/1344	Adenine bend, framework vibrations	(3,4)
	-/1403	N <sub>3</sub> -C <sub>4</sub> str, C <sub>10a</sub> -C <sub>4a</sub> stretch	(4)
	1625/1629	C <sub>6</sub> -C <sub>7</sub> str, C <sub>8</sub> -C <sub>9</sub> str, N <sub>5</sub> -C <sub>4a</sub> str	(4)
Alginate	908	ν <sub>sym</sub> C-O-C	(5)
	1117		
	1175	ν <sub>asym</sub> C-O-C	(5)
	1222	ν <sub>C-O</sub>	(5)
	1297	$\delta_{ extsf{C-H}}$	(5)
	1363	$\delta_{ extsf{C-H}}$	(5)
	1504	v <sub>asym</sub> COO	(5)
	1551	v <sub>asym</sub> COO	(5)
	1673		
Phosphate	1086	$v_{\text{sym}} PO_2^-$	(6,7)

## S1 Table references

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