

**Label-free SARS-CoV-2 Detection Platform Based on Surface-enhanced
Raman Spectroscopy with Support Vector Machine Spectral Pattern
Recognition**

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Table S1: Molecular information of Raman bands [1]

Peaks (cm ⁻¹)	Assignment
622	C-C twisting mode of phenylalanine (proteins)
638	Tyrosine ring breathing
659	C-S stretching mode of cystine (collagen type I)
768	Pyrimidine ring breathing mode
822	Phosphodiester
839	α -Anomers Glucose-saccharide band (overlaps with acyl band) Saccharide (α)
915, 916	Ribose vibration, one of the distinct RNA modes (with 915 and 974 cm ⁻¹)
939	C-C stretch backbone
1033	Differences in collagen content Phenylalanine mode $\nu(\text{CO})$, $\nu(\text{CC})$, $\nu(\text{CCO})$ (polysaccharides, pectin) CH in-plane phenylalanine (proteins)
1105	Carbohydrates peak for solutions
1111	Benzoid ring deformation
1154	β -Carotenes
1164	Tyrosine (collagen type I) Tyrosine
1220	C=N=C stretching Amide III (β -sheet)
1243	Amide III Asymmetric phosphate [PO^{2-} (asym.)] stretching modes (phosphate stretching modes originate from the phosphodiester groups of nucleic acids and suggest an increase in nucleic acids in the malignant tissues). (Generally, the PO^{2-} groups of phospholipids do not contribute to these bands)
1244	Amide III
1294	Methylene twisting
1296	CH ₂ deformation Ceramide
1337	Amide III and CH ₂ wagging vibrations from glycine backbone and proline side chain A, G (ring breathing modes in the DNA bases); C-H deformation (protein)
1363	Guanine (N ₇ , B, Z-marker)

1372	CH ₃ stretching; T, A, G (ring breathing modes of the DNA/RNA bases)
1405	CH deformation
1418	C-C stretching in quinoid ring
1457	Deoxyribose
1461	δCH ₂ , disaccharides, sucrose
1473	Paraffin
1481	Amide II (largely due to a coupling of CN stretching and in-plane bending of the N-H group; is not often used for structural studies per se because it is less sensitive and is subject to interference from absorption bands of amino acid side chain vibrations)
1506	Cytosine
1542	Single human RBC, amide II
1557	Tryptophan ν(CN) and δ(NH) amide II (protein assignment) ν(CC) porphyrin Tyrosine, amide II, COO ⁻
1569	COO ⁻
1595	C=N and CC stretching in quinoid ring
1615	Tyrosine, tryptophan, CC (protein) Adenine
1672	C-C stretch Amide I band (CO stretch coupled to a N-H bending) Ceramide

Table S2: Molecular information of Raman bands [1]

Peaks (cm ⁻¹)	Assignment
589, 590	Symmetric stretching vibration of ν ₄ PO ₄ ³⁻ (phosphate of HA) Glycerol
661, 663	C-S stretching mode of cystine (collagen type I)
708	ν(C-S) trans (amino acid methionine)
784	Phosphodiester; cytosine
837	Deformative vibrations of amine groups
839	α-Anomers Glucose-saccharide band (overlaps with acyl band) Saccharide (α)
931	Carbohydrates peak for solutions and solids
963	Unassigned in protein assignments CH ₂ ,6' out-of-plane bending

971	$\nu(\text{CC})$ wagging
1031	$\delta(\text{CH})$, phenylalanine (protein assignment) CH in-plane bending mode of phenylalanine Carbohydrate residues of collagen Phenylalanine, CN stretching of proteins CH in-plane bending mode of phenylalanine
1051, 1053	CO stretching, CN stretching (protein)
1090, 1091	Symmetric phosphate stretching vibrations
1130, 1131	CC skeletal stretch trans conformation Phospholipid structural changes (trans versus gauche isomerism) Acyl chains
1156, 1157	Carotenoids
1223, 1224	$\nu(\text{PO}_2^-)$, nucleic acids Cellular nucleic acids A concerted ring mode Proteins, including collagen I
1242	Amide III (β sheet and random coils)
1282	Differences in collagen content
1306	CH ₃ /CH ₂ twisting or bending mode of lipid/collagen CH ₃ /CH ₂ twisting, wagging, and/or bending mode of collagen and lipids
1318, 1319	G (ring breathing modes of the DNA/RNA bases); CH deformation (protein) Amide III (α -helix)
1351	Carbon particle
1359	Tryptophan
1369	Guanine, TRP (protein), porphyrins, lipids
1449, 1451	CH vibration (proteins) CH vibration (lipids) Lipids
1512	Cytosine
1518	$\nu(\text{CC})$, porphyrin Carotenoid peaks due to CC and conjugated CC band stretch
1549	Tryptophan
1587	Phenylalanine, hydroxyproline
1590	Carbon particles
1594	C=N and CC stretching in quinoid ring

Definition of evaluating metrics:

$$\text{Sensitivity} = \frac{TP}{TP+FN} \quad (1)$$

$$\text{Specificity} = \frac{TN}{TN+FP} \quad (2)$$

TP: True positive (3)

TN: True negative (4)

FP: False positive (5)

FN: False negative (6)

Table S3: Definition of confusion matrix

		Ground truth	
		Positive	Negative
Prediction	Positive	<i>True positive</i>	<i>False positive</i>
	Negative	<i>False negative</i>	<i>True negative</i>

References:

1. Talari, Abdullah Chandra Sekhar, et al. "Raman spectroscopy of biological tissues." *Applied spectroscopy reviews* 50.1 (2015): 46-111.