

any future neuronal death. The development of sensitive techniques for the diagnosis and treatment of neurodegenerative diseases.

Methods: Using surface-enhanced Raman spectroscopy (SERS), Alzheimer's disease (AD) and healthy age-matched control cerebrospinal fluid (CSF) was examined on a graphene-gold nano-pyramid hybrid substrate. Spectra were acquired from across each substrate with deposited CSF, such that hot spots with high signal intensity could be located and averaged for each patient.

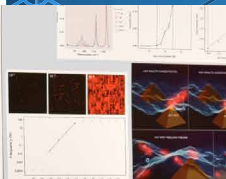
Results: We demonstrate the sensitivity and specificity of SERS to distinguish human CSF by double-blind experiments with a cohort of 28 individuals, using K-means clustering and Hierarchical Clustering Analysis (HCA). We demonstrate that our approach enables distinguishing AD patients from normal patients and even among patients within each cohort. Our data demonstrates the potential for the SERS platform to be applied as a medical diagnostic tool.

INTRODUCTION

There is broad consensus in the AD field that the development of biomarkers is critical if advances in diagnosis and treatment of the disease are to be achieved. A large number of AD biomarkers have been described, including those from blood and CSF, saliva, anatomical markers (MRI, PET, CT), infection, and neuropsychiatric status. CSF biomarkers have been of interest because they include molecules directly related to disease pathology.

We report here the development of methods and equipment coupled with powerful data analysis capabilities (computational power, Machine Learning (ML)/Artificial Intelligence (AI) that uses a highly selective and sensitive (single molecule) surface-enhanced Raman spectroscopy (SERS) platform to produce "spectromes" of biological samples that then are processed using ML/AI techniques to yield information on the biomolecules and underlying cellular status of the samples analyzed.

SERS is a label-free method that detects vibrational, rotational, and other low-frequency modes in a variety of biomolecules. Raman signals are detected over a broad wavenumber range (500-1500 cm⁻¹) and comprise resonances characteristic of proteins, lipids, DNA, RNA, and carbohydrates. SERS spectra are information-rich because of the large number of resonances that are observable and the rich chemical information in signal intensities therein, which allow the analysis of specific variations in signal intensities that are characteristic of the biomolecules not only of different types of biomolecules but of different states of the biomolecules. SERS is increasingly being applied in studies of neurodegenerative diseases because of its remarkable selectivity and sensitivity.



Concentration-dependence of Raman signal intensity (A) from 10⁻¹⁵ to 10⁻¹¹ M. Spectra from concentrations of 10⁻¹⁵ M are shown because they are essentially flat in the region of the 935 cm⁻¹ peak. Points are averages of three replicates from patient B. The blue line was used to calculate the low concentrations from 10⁻¹⁵ to 10⁻¹¹ M in the subsequent right: Diagram of analysis-quantification regimes.

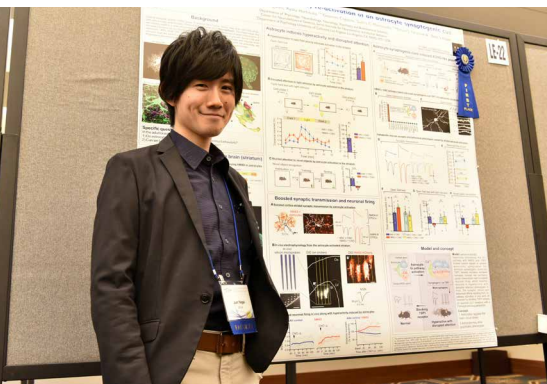
Cerebrospinal fluid	
	Healthy Control
# of cases	10
Male/Female	5/5
Age (years)	58 (42-74)
Adjusted age (years)	NA
CSF Aβ42 (pg/ml)	581 ± 91
CSF total tau (pg/ml)	344 ± 91
CSF p-tau (pg/ml)	183 ± 10
WMSR (SD)	23.9 ± 3.0
CSF SERS (D18)	83 (141-105)
CSF glucose (D18)	121 (117-125)
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- Open to all UCLA bioscience graduate students, post-docs, faculty, and research/project scientists
- Send a portrait PDF and a video/audio link explaining your poster
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- One free admission to LABEST for lead presenter