Martina Banchelli[1]
Cristiano D'Andrea[1], Edoardo Farnesi[1,3], Panagis Polykretis[1], Chiara Marzi[1], Edoardo Bistaffa[1], Federico Cazzaniga[2], Pietro Tiraboschi[2], Andrea Barucci[1], Marella de Angelis[1], Fabio Moda[2], Paolo Matteini[1]
[1]Institute of Applied Physics 'Nello Carrara' of the National Research Council of Italy (IFAC-CNR), via Madonna del Piano 10, 50019 Sesto Fiorentino (FI), Italy
[2]Division of Neuropathology 5, IRCCS Neurological Institute Foundation 'Carlo Besta', via Celoria 11, 20133 Milano (MI), Italy
[3]Friedrich Schiller University Jena, Fuerstengraben 1, 07743 Jena, Germany

m.banchelli@ifac.cnr.it

SERS and molecular seed amplification to make diagnosis of Alzheimer's disease

Alzheimer's disease (AD) is the most common neurodegenerative disorder in the elderly with an incidence that progressively increases worldwide. One of the main neurological hallmarks of AD is the presence of amyloid-β protein (Aβ) aggregates which forms extracellular plaques in the neurons. At present, clinical diagnosis of AD relies on criteria that permit to classify the disease as possible or probable and a definitive diagnosis of AD can be done only *post-mortem* through neuropathological examinations [1].
In this work, we present an innovative approach in which a seed amplification assay (SAA) capable to detect traces of pathological Aβ species in the cerebrospinal fluid (CSF) is combined with Surface Enhanced Raman Spectroscopy for the ultrasensitive analysis of CSF collected from extensively-characterized patients with AD [2,3]. An optimized and low-cost silver nanowires/PTFE SERS-active substrate is employed for the sensitive and reliable spectroscopical analysis of the CSF amplified samples, with the support of a machine learning algorithm for the classification of the patients.
Our findings show that the SERS analysis performed on SAA end products could reveal chemo-structural information useful to distinguish AD from other neurological impairments in living patients and these results well correlated with the other clinical, instrumental and laboratory findings.

References

[1] Albert, M. S. et al., Alzheimer's Dement., 7 (2011) 270.
[2] Bistaffa, E. et al., Brain Sci., 10 (2020) 815.
[3] Banchelli, M. et al., RSC Advances, 10 (2020) 21907.
[4] Barucci, A. et al., Analyst, 146 (2021) 674.

Acknowledgments

This research was funded by the European Community and the Italian Ministry of Education University and Research within the EuroNanoMed3 ERANET co-fund SPEEDY project (ID 221) and by the Tuscany Region in the framework of the Bando Salute 2018 PRAMA project.