Information and Brokerage Event
Horizon Europe 2023 Call
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VALIDATION OF FLUID-DERIVED BIOMARKERS FOR THE PREDICTION AND PREVENTION OF BRAIN DISORDERS

***Project Title*:**

Development of Fluorescence principles and platforms for the Early Detection of Biomarkers of Brain disorders in Body fluids

https://www.keralauniversity.ac.in/

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Presented by,

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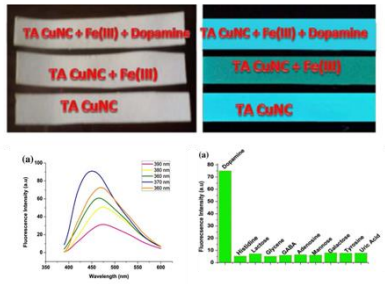
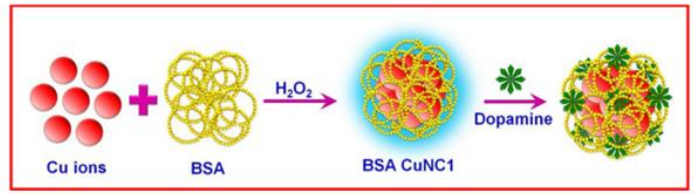


Area of Research –*Competencies*



Scheme 1. Diagrammatic illustration of the detection of dopamine using BSA CuNC synthesized in presence of H_2O_2.

https://doi.org/10.1007/s10876-017-1221-1.

https://doi.org/10.1016/j.jphotochem.2019.04.043

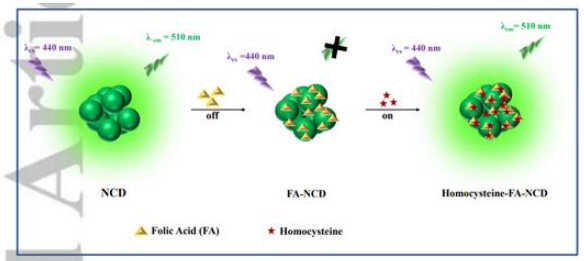
Design and Development of Fluorescent probes and assays for molecular diagnosis of disease biomarkers.

Fluorescent platforms:

- ***Fluorescent dye doped nanomaterials***
- ***Metal nanoclusters***
- ***Metal nanoparticles***
- ***Quantum dots***
- ***Carbon dots & carbonaceous materials***
- ***Lanthanide Luminescent and Upconversion nanoparticles***
- ***Molecular Imaging and sensing Luminomagnetic Nano particles for Bimodal Imaging Magnetic Nano particles***
- ***Superparamagnetism - MRI Contrast agents***

Mechanisms

- ***Fluorescence Resonance Energy Transfer (FRET)***
- ***Photoinduced energy transfer (PET)***
- ***Dexter energy transfer (DET)***
- ***Fluorescence Anisotropy***



Scheme 1. Schematic representation of Fluorescence response of FA-NCD towards homocysteine.

https://doi.org/10.1002/bio.4411

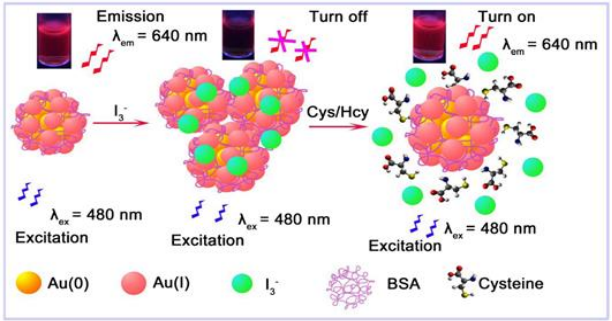
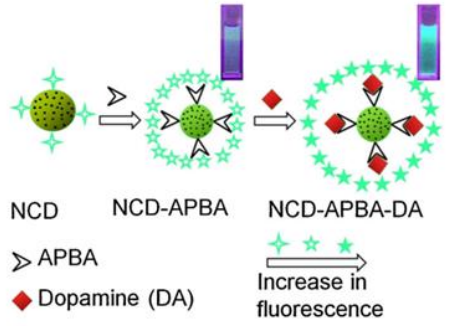


Fig. 1 The mechanism of sensing cysteine (Cys)/homocysteine (Hcy). I_2 induces S–S bond formation between gold nanoclusters (Au NCs) and results in turn off of fluorescence via aggregation. The thiol groups present in pristine Cys/Hcy break the S–S bond between Au NCs and switch on the fluorescence. BSA bovine serum albumin

https://doi.org/10.1007/s00216-018-1511-y



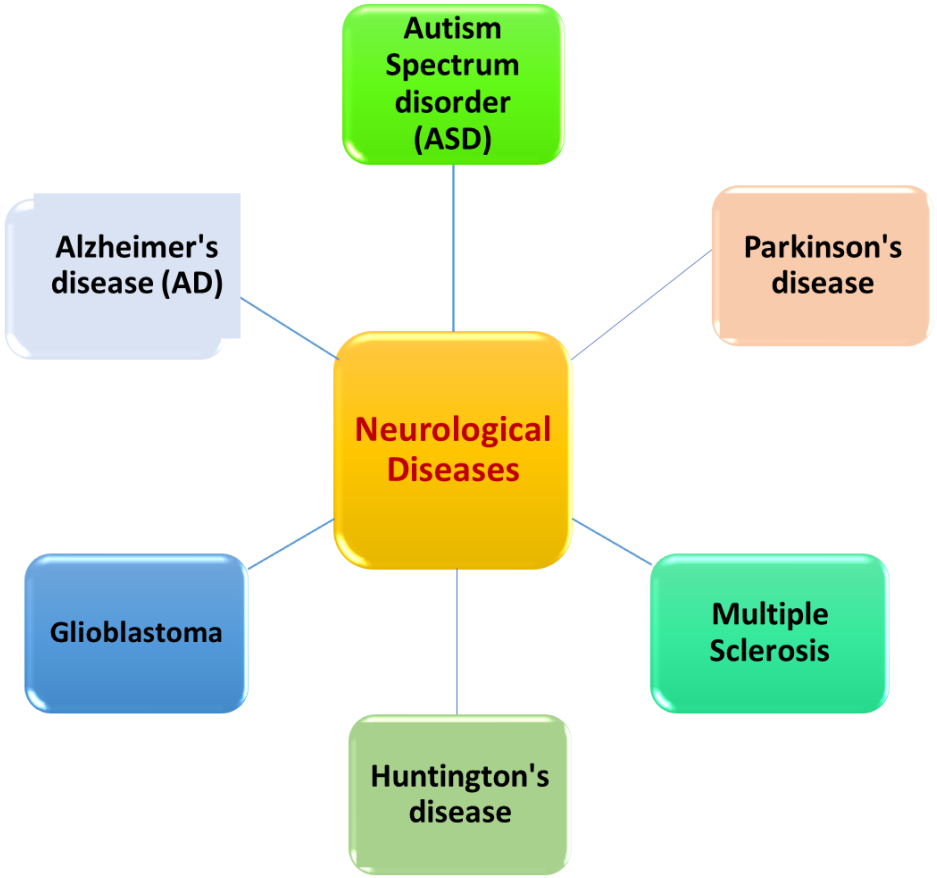
Scheme 1 The mechanism of the detection process for dopamine

https://doi.org/10.1007/s00604-017-2433-7

Sensing of Biomarkers for Brain Disorders

Biomarkers associated with neurological disease in Plasma/ CSF

- **Alzheimer's disease** Amyloid –β, α-synuclein, Tau protein
- **Parkinson's disease** - neurofibrillary tangles (NFT)
- **Early diagnostic biomarkers** : Metal ions (Zn, Cu, Fe, Na, Ca)
- ϒ-aminobutyric acid
- Autism Spectrum disorder



Prognostic markers

- β-casomorphin 7
- Neurofibril aggregation, nCRNAs
- Lipid hormones
- Amino acids- alanine, lysine,lactate

Emerging biomarkers

- Arachidonic acid
- Homovanillic acid
- Glial fibrillary acidic protein (GFAP)

Figure 1. Classification of AD biomarkers. The figure illustrates the classes of blood-based AD biomarkers

Research proposal

Methodology

- Fluorescence Anisotropic studies
- FRET based system for sensing (Upconversion and other fluorescent entities)
- Circularly polarised Luminescence
- Fluorescent imaging agents for image guided robotic surgery-

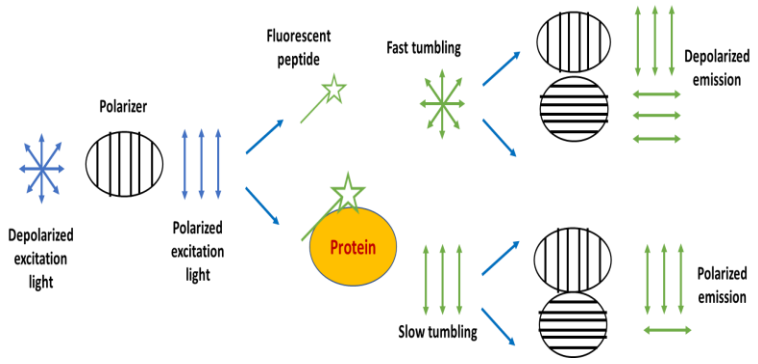


Figure 2. Exploring Anisotropic behaviour in protein aggregation

Requisite Expertise in Research area

- **Expertise and Resources sought**
- **Expertise : Optical Reading devices , Fabrication , Machine Learning Algorithm- Artificial Intelligence**

- **Circular Chemiluminescence Spectroscopy**
- **Expertise in chiral recognition of neurological markers using circularly polarized luminescence**

- **Resources: Biobanks, Clinical samples**

- **Seeking for clinical samples and clinical data bases augmented for early neurological biomarker testing.**

- **Image guided brain tumor surgery using fluorescence platforms.**

Indian Partners - *Committed*

1. **Dr. Migita M D'Cruz , DM Geriatric Psychiatry, Associate Consultant -KIMS Health , Thiruvananthapuram , KERALA, INDIA**

2. **Neurologists from SCTIMST , Thiruvananthapuram , KERALA, INDIA**

RESOURCES AVAILABLE AT UNIVERSITY OF KERALA

Central Laboratory for Instrumentation and Facilitation
https://kusicc.ac.in/

Equipment Intended to be Purchased in imminent future @University of Kerala Kariavattom Campus

Circular Dichroism Spectrometer, Small animal Imaging Facility ,High resolution transmission electron microscope (300 kv),Ultra-pure water supply , Cryocube (Deep Freezer),X-ray Diffractometer, Scanning Tunnelling Microscope, Impedance Analyser

Equipments available with the research group

Edinburgh FLS 1000 Integrated with Inverted Nikon Ti2 microscope for Molecular Fluorescence Imaging

Spectrofluorometer Jasco FP8300

Duetta Horiba Fluorescence and absorbance spectrometer

UV-Vis Absorbance Spectrometer Perkin- Elemer lamba 365

HPLC-Jasco Pu-2080

FTIR Spectroscopy Agilent technology Cary630

Advion expression LCMS mass spectrometer

Selected List of Publications

1. Aparna, R.S., J.S. Anjali Devi, John Nebu, S.S Syamchand, and Sony George. “Rapid Response of Dopamine towards Insitu Synthesised Copper Nanocluster in Presence of H2O2.” Journal of Photochemistry and Photobiology A: Chemistry (Elsevier) 379 (June 15, 2019): 63–71. https://doi.org/10.1016/j.jphotochem.2019.04.043

2. Anjali Devi, J. S., A. H. Anulekshmi, S. Salini, R. S. Aparna, and Sony George. “Boronic Acid Functionalized Nitrogen Doped Carbon Dots for Fluorescent Turn-on Detection of Dopamine.” Microchimica Acta (Springer), 184, no. 10 (October 2017): 4081–90. https://doi.org/10.1007/s00604-017-2433-7

3. Aparna, R. S., S. S. Syamchand, and Sony George**.** “Tannic Acid Stabilised Copper Nanocluster Developed Through Microwave Mediated Synthesis as a Fluorescent Probe for the Turn on Detection of Dopamine.” Journal of Cluster Science (Springer), 28, no. 4 (July 2017): 2223–38. https://doi.org/10.1007/s10876-017-1221-1.

4. Anjali Devi, J. S., B. Aswathy, Sasidharan Asha, and Sony George. “Lactose Tailored Boronic Acid Conjugated Fluorescent Gold Nanoclusters for Turn-on Sensing of Dopamine.” Journal of Analytical Chemistry (Springer), 72, no. 4 (April 2017): 445–59. https://doi.org/10.1134/S1061934817040037.

5. Nebu, John, J. S. Anjali Devi, R. S. Aparna, B. Aswathy, G. M. Lekha, and George Sony. “Potassium Triiodide-Quenched Gold Nanocluster as a Fluorescent Turn-on Probe for Sensing Cysteine/Homocysteine in Human Serum.” Analytical and Bioanalytical Chemistry (Springer), 411, no. 5 (February 2019): 997– 1007. https://doi.org/10.1007/s00216-018-1511-y

6**.** Saralammma Madanan Anju, Asokan Omana Aswathy, Susan Varghese, Merin Kodinattumkunnel Abraham, Ragini Sanjeevan Lekshmi, Ali Ibrahim Shkhair, Girija Muraleedharan Lekha, Sasidharanpillai S. Syamchand, Sony George,”Folic acid incorporated nitrogen-doped carbon dots as a turn-on fluorescence probe for homocysteine detection”, Luminescence (Wiley),Volume 38, no: 19-27, (November 2022), https://doi.org/10.1002/bio.4411.