Lighting Up the Brain: Development of a Novel Molecular Probe for the Early, Minimally-invasive Diagnosis and Treatment of Alzheimer’s Disease

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Alzheimer’s disease (AD) is a neurodegenerative disease in which current diagnostic tools are invasive and lack the ability to diagnose early-onset dementia. Current antibody-based diagnostic tests for neurodegenerative diseases require invasive measures such as a lumbar puncture, and lack specificity to biomarkers that are found in both healthy individuals and patients with AD. In this project, a design for a carbon dot(CD)-bound bispecific antibody is developed for the minimally-invasive diagnosis of AD. The molecular probe can be easily synthesized with a specificity to amyloid-beta (Aß) oligomers as it distribution and abundance in the brain suggest they are better predictors of disease progression and are present in the early-onset of the dementia. The bispecific antibody conjugated to the CD displays a low affinity to transferrin receptors (TfRs) which allows the probe to cross the blood-brain barrier via receptor mediated transcytosis leading to a minimally invasive diagnosis. A synthesis technique was developed to conjugate the bispecific antibody to the CD. As a proof of concept, this technique was used to couple bovine serum albumin (BSA) to CDs. The structural and optical properties of the CDs were observed. By synthesizing a novel carbon dot conjugated specific antibody that emits light at a specific wavelength in the near-infra red region, the molecular probe displays optical properties suitable for the minimally-invasive diagnosis using fNIR-spectroscopy.

Awards Won:

Patent and Trademark Office Society: Second Award of $500