Fabrication of a Europium-Based Magnetic Nanosensor for the Detection of D-Serine in Early-Onset Alzheimer’s

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Nearly 6.7 million Americans age 65+ are currently affected by Alzheimer's disease (AD). Preliminary diagnosis of AD is a difficult and time-consuming process that often leads to false outcomes. Moreover, accurate testing is painful and invasive. Both drug/nondrug interventions are vastly more effective for patients diagnosed in the early stages of AD, as these treatments can slow the decline of memory and other cognitive skills. An effective, sensitive, and rapid diagnostic for early-AD is imperative to provide the most meaningful therapeutic result. Recent literature by Piubell (2021) has outlined D-serine as a biomarker for Alzheimer’s, as D-serine levels are positively correlated with disease progression. Additionally, D-serine is detected in the blood serum, making it less invasive than current methods. Thus, a europium-based nanosensor for rapid detection of D-serine in serum was created for early diagnosis of AD. A magnetic, luminescent sensor was fabricated, based first on the synthesis of Fe_3O_4, which was encapsulated with $CePO_4$, Tb, and EDTA-Eu ligands, to produce a multicolor nanoprobe exhibiting blue-to-red emissions at 480nm, 536nm, 582nm, and 610nm, using 260nm excitation. This nanoprobe is responsive to the addition of dipicolinic acid (DPA), and subsequently D-serine, where red luminescence wavelengths are enhanced, producing a green-to-red color change. With fixed addition of 30μM-DPA to the Fe_3O_4-$CePO_4$-Tb-EDTA-Eu nanoprobe, the color-response of the resulting Fe_3O_4-$CePO_4$-Tb-EDTA-Eu-DPA nanoprobe was linear with D-serine concentrations added, producing an ideal visual sensor for the early onset AD. Work is ongoing to transfer the nanoprobe to a paper sensor, to create a point-of-care, early-AD diagnostic.

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