## ABSTRACT

Breast cancer has been reported to be one of the leading causes of death globally and late diagnosis is a significant reason of low survival rate among the patients. The identification of reliable biomarkers such as Mucin 1 (MUC1) has provided opportunities to develop quick, economical and sensitive diagnostic devices. The traditional approaches, such as imaging and immunoassays, are accurate but often costly, invasive, and unsuitable for point-of-care (POC) applications, particularly in low resource settings. This work presents the synthesis and characterization of a $CeCuO_3$ doped lanthanum strontium cobalt ferrite (LSCF) perovskite based 3D printed aptasensor for the colorimetric detection of MUC1, a breast cancer biomarker. The $CeCuO_3$ doped LSCF perovskite was synthesized and characterized by FTIR, XRD, SEM, zeta potential, and dynamic light scattering (DLS). Functionalization with MUC1 specific aptamers provided high selectivity toward the target antigen, while the non-enzymatic catalytic activity of the perovskite material facilitated the colorimetric reaction. The fabricated aptasensor exhibited a broad linear detection range of 0.00125-1 U/mL, excellent selectivity against common interferents, along with reproducibility and high stability. Its analytical reliability was further validated through successful detection of MUC1 in human serum samples, achieving recovery rates between 97.4% and 100.8%. This work not only contributes to biosensor technology but also emphasizes the integration of nanomaterials and additive manufacturing in creating strong, portable, and affordable diagnostic equipment.