trivial task. The major challenge lies in the ability to identify and quantify molecules of interest, often at low concentrations, using rapid, non-invasive, cost-effective, and simple to use than currently available methods while still preserving the high standard of selectivity and sensitivity required for accurate testing. For this reason, nanodiagnostics is centered on the development of innovative tools for early detection of disease-related entities, which requires the recognition and quantification of low amounts of disease biomarkers.

In this context, the aim of this research lies in the exploration of the fabrication and the spectroscopic properties of gold-based nanostructures (AuNPs) with defined size, shape, and surface coatings with tunable self-assembled mixed monolayers (mixed-SAMs) made from short chains. By controlling the surface chemistry of the assembly structure, the key target is to optimize design approaches that can be tailored to develop a non-invasive nanodiagnostic platform for cancer-related biomarkers. Coupled with this, further consideration has been undertaken to investigate the potentiality of a novel approach based on a miniaturized gel electrophoresis chip (MGEC) integrated with online thermal lens (TL) detection for monitoring the surface functionalization of the nanoparticles with an attempt to combine the robustness of the plasmonic agent and the ultra-sensitivity of TL spectroscopy.