Insertion loss reduction in SAW device through ZnO nanoparticle coating toward cell migration applications

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Abstract. Surface acoustic waves (SAW) have been widely utilized for particle manipulation and cell migration due to their high efficiency and non-invasive nature. However, the presence of cell media and PDMS-based confined area can lead to significant insertion loss, which limits their effectiveness in biological applications. In this study, we explored the use of a ZnO nanoparticles to enhance the performance of SAW devices by reducing insertion loss for cell migration applications. Prior to fabrication, simulations were conducted to analyze the effect of the ZnO nanoparticles on the interdigital transducer (IDT). The simulation results indicated an improvement in the reflection coefficient and a significant increase in maximum surface displacement, suggesting enhanced device performance. Following the simulations, the SAW device was fabricated using standard microfabrication techniques, with ZnO nanoparticles coating achieved via spin coating. The presence of the ZnO nanoparticles was confirmed using UV-Vis spectrometry before ZnO nanoparticles coating, while the surface morphology was characterized through scanning electron microscopy (SEM). Electrical testing of the fabricated device using a vector network analyzer (VNA) revealed a substantial reduction in insertion loss compared to the SAW device without the ZnO nanoparticles. This reduction in insertion loss suggests that the ZnO nanoparticles improves the device's ability to generate acoustic waves with higher efficiency. This improvement enables

the device to induce higher mechanical stress on cells, highlighting its potential for applications in cell migration and other biomedical fields.