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Composite superlattice radio-frequency surface-acoustic-wave devices

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Abstract

The consumer demand for the next generation telecommunication devices with increasing performance and miniaturization imposes strong constraints on radio frequency (RF) surface acoustic wave (SAW) devices such as low-cost, low insertion loss, and small footprint. We employ COMSOL © Multiphysics finite element analysis (FEA) software to investigate the properties of realistic SAW RF devices with a thin film located along the delayline between the source and detector interdigitated transducers (IDTs) on a 128[o]Y-cut lithium niobate (LN) substrate. In these simulations, a chalcogenide phase change material (PCM), germanium-antimony-telluride (GST), is chosen for the thin film material that could be converted to desired superlattices (SL) constituted of crystalline and amorphous segments. Here two types of SL configurations, with crystalline to amorphous segments ratios of 1:1 and 1:2, are investigated, and corresponding frequency responses are discussed. The primary outcome of this work is the demonstration of a SL-RF duplexer and a topological acoustic narrowband resonator in a SAW device that otherwise acts as a broadband filter. This work shows that a SL with thickness amounting to 1/10th of the wavelength of the SAW can drastically affect the transmission of the composite device through mode hybridization between Bloch waves in the SL and SAW in the LN substrate.

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