

Lithium tantalate reflective delay line as passive sensor for detection of BTEX in subsurface water.

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In the context of detecting sub-surface water pollution of water by Benzene, Toluene, Ethylbenzene or Xylene (BTEX), a reflective delay line was developed with time-delays compatible with Ground Penetrating RADAR (GPR) operation (1-4 us) at center frequency ranging from 100 to 200 MHz, getting rid of clutter by time-division multiple access with the first echo well beyond the sub-surface reflector echoes in temperate environments, and yet able to operate in liquid phase without dedicated microfluidic packaging. This result is achieved by using the strongly coupled lithium tantalate oxide (LTO) piezoelectric substrate for low insertion losses, and yet high relative permittivity for insensitivity to the impact of capacitive short circuit by surrounding water when exposed to the pollutant. While the acoustic transducer provides the high gravimetric sensitivity through the acoustic velocity to sensor layer mass (density) dependence, the latter functionalized thin film provides the chemical selectivity. Indeed, organic solvents included in BTEX are well known for their low reactivity with most organic and inorganic molecules, and an original chemical sensing mechanism is demonstrated to selectively detect BTEX compounds with no detectable interference from aliphatic ethers that are well-known as interferent in water pollution monitoring with detection limit in the ppm range.

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