Quartz tuning fork as a multipurpose tool for low temperature research - recent development

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Quartz tuning forks (QTFs) are a recent addition to the family of oscillating structures that have been widely used as tools in cryogenic fluid dynamics and in quantum fluids research since the discovery of superfluidity. These cheap, highly sensitive, robust and easy to install piezoelectric oscillators can be used as multipurpose cryogenic tools, via their ability to probe the flow of surrounding cryogenic helium. QTFs can be used as secondary thermometers, pressuremeters, viscometers, turbulence and cavitation generators and detectors, as well as flowmeters in various cryogenic applications in helium gas, normal liquid ^{3}He and He I, in superfluid He II, ^{3}He-^{4}He mixtures as well as in superfluid ^{3}He phases at submillikelvin temperatures (custom-built QTF arrays can be used to visualize quantum turbulence here). Only two shielded wires are needed to drive and readout the QTFs; simple electronic schemes allow detection of their resonant response both in classical and quantum fluids over up to eight orders of magnitude of the driving force. No magnetic field (to which they are highly insensitive) is required to drive QTFs; both the fundamental resonance and overtones can be excited and used for measurements. We discuss recent investigations of acoustic emission by QTFs that, besides being an interesting subject of study in its own right, in practice represents a limiting factor (together with the nuisance damping due to material properties of QTFs) for their sensitivity, especially for their ultra-low temperature applications.

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